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Insurance and Risk Management Tools for Agriculture in the EU

European Commission

European Investment Bank

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Abbreviations

Abbreviation	Full name
AAL	Annual Average Loss
AFD	Agence Française de Développement
AITAP	Agriculture Insurance Technical Assistance Platform
ARC	African Risk Capacity
ARMA	Agency for Restructuring and Modernisation of Agriculture
BMZ	The Federal Ministry for Economic Cooperation and Development
BWV	Brede Weersverzekering
CAP	Common Agricultural Policy
CCRIF	Caribbean Catastrophe Risk and Insurance Facility
Consorcio	Consorcio de Compensación de Seguros
DG AGRI	Directorate-General for Agriculture and Rural Development
DG CLIMA	Directorate-General for Climate Action
DG FISMA	Directorate-General for Financial Stability, Financial Services and Capital Markets Union
EAFRD	European Agricultural Fund for Rural Development
EAGF	European Agricultural Guarantee Fund
ECB	European Central Bank
EIB	European Investment Bank
EIOPA	European Insurance and Occupational Pensions Authority
ELGA	Hellenic Agricultural Insurance Organisation
ENESA	Entidad Estatal de Seguros Agrarios
ESRB	European Systemic Risk Board
ESSL	European Severe Storms Laboratory

EU	European Union
FADN	Farm Accountancy Data Network
FAO	Food and Agriculture Organization
FEADER	Fonds européen agricole pour le développement rural
FNGCA	Fonds National de Garantie des Calamités Agricoles
FNGRA	Fonds National de Gestion des Risques en Agriculture
GDD	Growing Degree Days
GPD	Generalised Pareto Distributions
GWP	Gross Written Premium
MRC	Multi Risques Climatiques
PDSI	Palmer Drought Severity Index
PML	Probable Maximum Loss
PoT	Peaks over Threshold
PPP	Public-Private Partnership
PDSI	Palmer Drought Severity Index
RCP	Representative Concentration Pathway
SEDA	Swedish International Development Cooperation Agency
SME	Small and medium-sized enterprise
SPEI	Standardised Precipitation-Evapotranspiration Index
SPI	Standardised Precipitation Index
SSP	Shared Socioeconomic Pathways
UAA	Utilised Agricultural Area
UN	United Nations
WTS	Wet Tegemoetkoming Schade bij rampen (Disaster Damage Compensation)

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Structure overview

This report is structured as follows:

Part 1 gives an overview of agricultural climate risk trends across Europe under the current climate and in 2050.

Part 1.1 introduces the key concepts of risk modelling used throughout this report and rooted in best practice from the insurance industry.

Part 1.2 gives an overview of the expected changes to primary perils (drought, frost, hail and rain) as a result of climate change and the expected impact on European agricultural production.

Part 1.3 details each of these four perils.

Part 2 provides an overview and classification of agriculture insurance schemes in the EU.

Part 2.1 outlines agricultural risk management tools, explicitly those available in Member States through the CAP or otherwise.

Part 2.2 provides an overview of the different types of agricultural insurance systems within the EU and classifies Member States by their insurance system characteristics, including public intervention, market size and scope.

Part 3 analyses the performance of agricultural insurance systems in ten example Member States.

Part 3.1 introduces the concept of 'risk layering' to ensure equitable risk sharing and effective risk management.

Part 3.2 dives deeper into the agriculture insurance systems of ten Member States, including key reference information, performance during historic events, current and future risk modelling results, and quantitative estimates of protection gaps facing these countries.

Part 4 offers observations from the overall analysis.

Part 4.1. reviews whether EU agriculture systems are sufficient and sustainable in the face of current and future climate risks.

Part 4.2 summarises other risk management systems in major agricultural economies.

Part 4.3. highlights agriculture adaptation measures, given the need revealed in the risk assessments.

Part 4.4 discusses how increasing climate risks may affect access to finance and the way the credit industry serves the agriculture sector.

Part 5 suggests eight recommendations to support the resilience of EU agriculture and the financial sustainability of insurance systems.

Executive Summary

This report responds to the mandate given to the EIB in the **Strategic Dialogue on the Future of EU Agriculture (September 2024)** to explore forms of support for agriculture insurance schemes and other climate adaptation de-risking schemes in agriculture systems.

The report delivers:

- A **comprehensive quantification** of current and future climate-related agriculture financial risks to crops across the European Union under present conditions and up to 2050.
- A classification and evaluation of the **performance of current insurance systems** and wider public prearranged finance to cover those risks.
- Estimates of uninsured risks and losses, the **protection gap** that falls on farmers and governments.
- A comprehensive inventory of agriculture insurance systems across the EU with a detailed analysis of ten Member States that represent the range of different insurance systems.

It is the first time that such a risk quantification has been carried out consistently across the EU with the type of risk metrics used by global risk capital markets and insurance regulators, including the European Insurance and Occupational Pensions Authority (EIOPA) and Member State insurance supervisors. This allows the agricultural climate risk analysis in this report to align with insurance systems and inform insurance related impacts and policy considerations.

To obtain a robust baseline for modelling current and future risks, we conducted a historical analysis of EU yields and climate events since the 1980s, supplemented by literature reviews. This identified what perils, at what intensities, affect which crops, allowing us to establish vulnerability functions to model current and future risks comprehensively and consistently. We believe this form of data assimilation across the EU is unprecedented. This process highlighted various data challenges across the EU and informed recommendations to develop the data infrastructure required to improve agricultural climate risk management and insurance systems.

In line with insurance sector practice, the report categorises risks into layers of frequency and severity:

- **Risk Layer 1: Attritional losses**, caused by high frequency, low intensity events. These usually fall below insurance payout thresholds or are uninsured. Frequent small losses can gradually erode financial reserves and business viability for farms.
- **Risk Layer 2: Severe losses**, caused by medium frequency, medium intensity events. Such losses are often covered by insurance-related programmes. Despite this, across the EU there is a considerable protection gap for specific crops and climate perils as insurance is not always available or affordable.
- **Risk Layer 3: Catastrophic losses**, caused by low frequency, high intensity events. These occur infrequently but inflict extensive damage, often across multiple Member States, usually exceeding insurance coverage and requiring government intervention, including unplanned public expenditure.

Key Findings

Current Situation

- **EUR 28.3 billion: The current estimated Annual Average Loss (AAL)** for the EU-27, which is approximately 6% of annual EU crop and livestock production.[1] This key insurance metric is the average of the many years with relatively low losses, the few years with severe losses and the infrequent years with catastrophic losses. It comprises **EUR 17.4 billion** for crops (6.4% of EU crop production) and **EUR 10.9 billion** for livestock (5.1% of EU livestock production). The EU-wide average masks significant regional variations depending on differences due to perils, local conditions and crops, as described in the report. In general, loss events are increasing in frequency, severity and duration.
- **Drought drives over 50% of agricultural climate risk across EU-27 and warrants priority attention.** The impact is heightened because drought is significantly underinsured across the EU, with limited, if any, insurance coverage available in many regions. Four perils (drought, frost, hail and excess precipitation) drive approximately 80% of climate-related agricultural losses across the EU.
- **EUR 57.5 billion: The current estimated Probable Maximum Loss (PML) for the EU-27 in a catastrophic year** (2% annual probability) is made up of **EUR 35.1 billion** for crops and **EUR 22.4 billion** for livestock. (In comparison, the 2022 EU drought has been estimated to have caused, up to EUR 25 - 30 billion of losses to crops only).[2]
- **70-80%: the current Insurance Protection Gap.** Only 20-30% of climate-related losses are insured via public, private or mutual systems, including Common Agricultural Policy (CAP) supported protection. These averages mask considerable variations across Member States, including cases where protection is non-existent. Despite this overall protection gap, there are many examples of effective insurance protection systems, and promising reforms and innovations, that can be shared and learnt from.

Future Scenarios (to 2050)

- **42-66% increase in crop annual average crop losses.** Crop AALs are estimated to increase from **EUR 17.4 billion to EUR 24.8 billion** under a medium emissions scenario (SSP2-4.5) and **EUR 28.9 billion** under a business-as-usual emission scenario (SSP 5-8.5.). If related livestock losses are included, it is foreseeable that EU-27 AALs could reach **EUR 40 billion** by mid-century. These EU-wide averages mask much higher increases for some exposed crops and regions.
- **Drought risks** will intensify in south, south-eastern and central parts of the EU, but will also extend north and west to regions and crops less accustomed and more vulnerable to arid conditions. The importance and urgency of managing, reducing and financing drought risks to farmers, creditors and rural economies across the EU is an **acute priority identified in this report**.
- **Frost losses** to high value EU crops will increase, illustrating the breadth and complexity of managing future climate risks in a period of climate warming. For example, earlier biological springs lead vines and fruit to bud and blossom, increasing vulnerability to frost in later February, March and early April.
- **45-63% increase in the 2050 EU Crop PML** under medium emissions and business-as-usual emissions scenario, to **EUR 51 – 57 billion** with related livestock losses this could foreseeably rise above **EUR 90 billion**.

1 Annual Average Loss figure from the authors modelling. Percentage is derived from 'Eurostat (2024). Performance of the agricultural sector'.
2 Pinke, Z., Ács T., Kalicz, P., Kern Z,. Jambor., A (2024) 'Hotspots in the EU -27 and Economic Consequences of the 2022 Spring-Summer Drought'.

General Observations

- **Adaptation and Resilience:** To maintain farm insurability and viability, climate risks will need to be contained or reduced within tolerable parameters, requiring adaptation interventions at scale. Adaptation measures are crucial in the insurance subsidised layer to support insurability as risks increase, and essential in the uninsured layer as attritional losses grow in frequency.
- **Climate Risk Financial Regulatory Reforms:** Under current reforms at global and EU levels, financial institutions, including agricultural lenders, are being required to quantify and manage climate-related risks. While these changes aim to enhance financial system resilience, they may restrict access to credit and increase costs for farmers and rural communities, amplifying the financial pressures from climate risks.
- **Maintaining Insurability:** This will become a strategic issue for the EU agriculture sector to ensure financial security and ongoing access to credit, as well as the economic vitality of rural regions.

Recommendations

The recommendations in this report fall under three interdependent pillars.

- **Understanding EU Agriculture Climate Risks through improved Data, Analytics and Modelling (Recommendations 1, 2 and 3).**

  The project has identified the need to improve the collection and assimilation of crop, climate and yield data across the EU to support greater understanding and management of risks as well as enabling wider risk sharing across insurance and risk capital markets.

- **Managing and financing EU catastrophic agriculture climate risks (Recommendations 4, 5 and 6).**

  While insurance protection can be improved at all levels, including within Member States, there is a need at EU level to support the financial response to catastrophic events. The recommendations include enabling EU institutions and Member States to access risk capital markets, including (re)insurance and catastrophe bonds, to supplement resources and times of crisis.

- **Enhancing agriculture adaptation and financial resilience (Recommendations 7 and 8).**

  The relentless growth in smaller but frequent attritional losses affects the financial health of farms across the EU. With fewer 'good' years to fall back on for recovery, farm margins and reserves risk being steadily eroded. This increases vulnerability to the impact of larger events and stretches access to credit. Policies should maximise climate resilience through interventions at farm and regional level.

To support these developments, the report also recommends the formation of an EU Agriculture Insurance Technical Assistance Platform (AITAP). This would provide a focal point for EU institutions, Member States, industry, academia, NGOs and the wider public to share knowledge and best practice. Such an initiative would also provide a vehicle to take many of these proposals to the next stage of research, development and innovation.

Table 1: Summary results for modelled EU agricultural AAL from driving climate perils. All figures in EUR billion unless stated otherwise.

Metric		Present Day	Future Scenario (2050, SSP2-4.5)	Change (%)	Future Scenario (2050, SSP5-8.5)	Change (%)
AAL	Crops	17.4	24.8	+42%	28.9	+66%
	Livestock	10.9	15.3*	+40%	17.8*	+63%

Table 2: Summary results for modelled 1-in-50 year PML for EU agriculture from driving climate perils. All figures in EUR billion unless stated otherwise.

Metric		Present Day	Future Scenario (2050, SSP2-4.5)	Change (%)	Future Scenario (2050, SSP5-8.5)	Change (%)
1-in-50 PML	Crops	35.1	51.0	+45%	57.0	+62%

* See note on future climate projections for livestock in Annex II: Methodology for Risk Modelling of the PML curves as part of the agricultural outputs for different hazard types.

Part 1

Agriculture climate risk trends across Europe, now and 2050

Part 1.1 The building blocks of quantifying risk

This report has quantified current and future expected losses to EU agriculture applying risk modelling methods and metrics used by the (re)insurance sector and wider risk capital markets, as well as their regulators and supervisors, to design financial protection products and ensure there is sufficient capital in the system to cover foreseeable payouts. These methodologies are also employed by prearranged disaster financing facilities put in place by governments or development banks.

Beyond securing risk capital, such modelling approaches are evolving to meet broader needs. They are increasingly applied in governmental risk assessments, adaptation plans, relief organisations supporting humanitarian finance, corporate disclosures of physical climate risks, investments in resilient infrastructure and global risk assessment mandates from entities such as the UN Office for Disaster Risk Reduction and the World Bank Global Facility for Disaster Risk Reduction.

Risk modelling: key elements

Since the early 1990s, underwriters, regulators and credit rating agencies have been implementing an approach to natural hazard risk assessment called catastrophe risk modelling. It blends four disciplines: engineering metrics and expertise, actuarial science, physical and human geography and, more recently, climate science.

The challenges of evaluating the probability and magnitude of infrequent, extreme and often unprecedented events has led to the development of three distinctive features of catastrophe risk modelling techniques:

- Better quantification of what could happen this year, at current levels of risk, and not as an average of what has been recorded in the past.
- Catastrophe models operate at higher spatial resolution than climate models to simulate detailed impacts of a hazard on defined assets. Climate models work at a lower spatial resolution with individual 'cells' of many kilometres in dimension, far too large to 'resolve' individual weather events in detail.
- Catastrophe risk models integrate three modules: hazard, exposure and vulnerability, while climate models focus on the hazard.

Hazard module

The hazard module calculates the annual probability of a defined hazard occurring at a specific location (e.g. a defined drought intensity or a defined wind speed).

The hazard module combines:

- historical hazard data;
- meteorological expertise;
- stochastic statistical techniques;
- climate models.

This combination simulates the range of events, such as droughts, windstorms, frost, hailstorms, excess rain and floods, with their location, duration and intensity.

The hazard module usually simulates 10 000 potential years of loss events (e.g. droughts or frost). The goal is to simulate 10 000 years equivalent to current conditions, not to recreate the last 10 000 years of history or look ahead 10 000 years. This statistical database is needed for two reasons:

- Historic losses are insufficient to evaluate current levels of risk and do not represent current or future probabilities of weather events due to climate change.
- Obtaining the frequency and extent of extreme events requires a very large sample of modelled years. For example, for calculating a 1-in-100-year event (1% annual probability), one thousand modelled years would only provide ten 100 year blocks, which would not be sufficient as a reliable sample to evaluate an average 1-in-100-year event.

Applying climate change models

Climate models inform current levels of risk as well as future projections. They are used as inputs to influence the hazard module with, for example, increased heat, which in turn increases the volume of water held in the atmosphere and the frequency and intensity of a precipitation event.

Using this approach, in this analysis we have climate conditioned the hazard modules to simulate the expected patterns of different perils across the EU at present and in 2050. We have based this climate conditioning on the SSP2-4.5 and SSP5-8.5 climate change scenarios. These correspond to an average surface temperature increase of around 2°C and 4°C respectively by 2100. The impact and influence of higher and lower emission pathways is relatively similar over the next 25 years, with carbon reduction strategies delivering their main impacts in the second half of the century.

Exposure module

This module represents the geolocation and attributes of the exposed assets (e.g. crop type and growth stage).

Adaptation and resilience

These measures improve the attributes of exposed assets against defined hazard intensities. In this study, future modelled agricultural losses (2050) are based on current exposures; no changes in crop production values, planting patterns or technologies have been accounted for.

In reality, agricultural systems are continually adapting to changing markets, policies and climate conditions. For example, mechanisms such as the EU Adaptation Strategy, the Land Use Change and Forestry Regulation and CAP aim to build resilience to climate risks through adaptation. The results presented in this report emphasise the importance of these measures, as potential losses at current levels of exposure present a stark reality.

Vulnerability function

This function calculates how much damage to the exposed assets is expected under different levels of hazard. In this report, it means the relationship between weather events and yield losses.

Training the vulnerability function

A historic analysis is necessary to train, calibrate and support the vulnerability function of the risk models. In this case, we evaluated 40 years of pre-2024 EU losses to understand the relationship between events and losses: what perils, at what intensity, affect which crops and in which locations. This relationship between weather events and yield losses creates a baseline to model current and future risk.

A key part of this process involved standardising and normalising heterogeneous and patchy yield loss data across the EU.

Key metrics

The results of the hazard module are applied to the exposure and vulnerability modules to obtain two key metrics:

Annual Average Loss (AAL)

This is the average of all losses across the sample of simulated years, including years of no losses, years of medium losses and years of very high losses (e.g. AAL to yields).

AAL to yields can be converted into annual average financial losses through an additional financial module inbuilt within the risk model (e.g. a loss of 1% of yield produces x euros of financial loss). This is known as 'pure price of risk', 'technical rate' or 'pure premium' (the price of risk in the insurance premium before adding costs, expenses and profit).

Probable Maximum Loss (PML)

PML relates to the expected frequency and magnitude of extreme events. The large sample of 10 000 years enables an estimation of the largest losses expected at current or future levels of risk (e.g. PML to yields). As with AAL, a PML can be converted into financial losses.

Important Note

AALs can be summed. For example:

- frost, drought, rainfall and hail AALs can be added to evaluate a multi-peril AAL;
- the AALs of each of the 27 Member States can been added to calculate the total EU AAL.

PMLs cannot be summed. This is because not all perils in a country, or all Member States in the EU will have their own 1-in-50-year PMLs in the same year. This peak risk distribution principle is at the heart of insurance. The estimation of diversification benefits of multi-peril and multi-territory PMLs is a key underwriting function and requires a knowledge of the distribution patterns and correlations of different climate perils.

We have applied these techniques in the analysis. When reading the report **individual PMLs do not add up to the combined PML of perils or geographies.**

Risk Classifications

Risk is the exposure and vulnerability to the intensity and frequency of a hazard. This report categorises crop losses into three layers:

- **Risk layer 1: Attritional Losses (high frequency, low intensity events):** Events that have approximately 10% to 20% annual probability of occurring.
- **Risk layer 2: Severe Losses (medium frequency, medium intensity events):** Events in an approximate range of 2% to 10% annual probability of occurring.
- **Risk layer 3: Catastrophic Losses (low frequency, high intensity events):** Events with a 2% or lower annual probability of occurring.

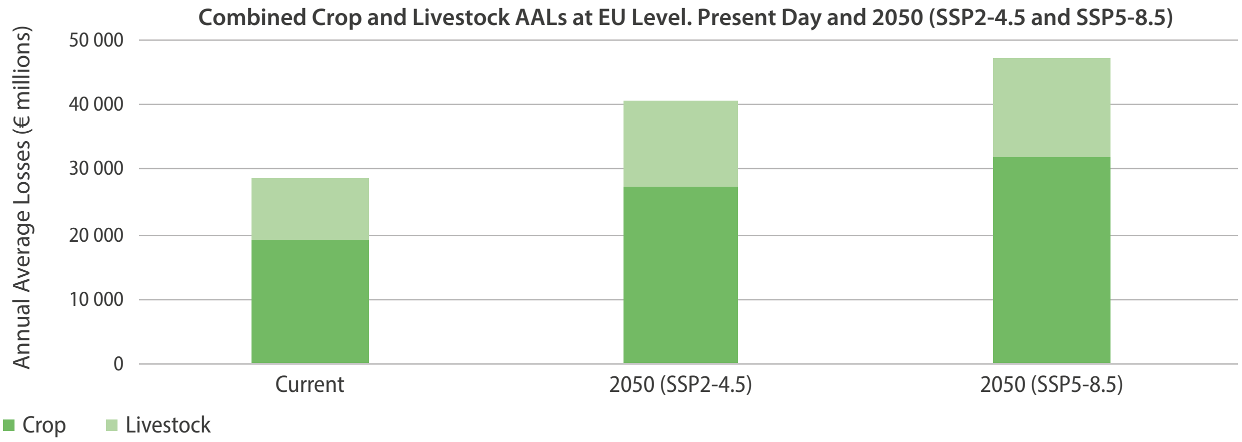
Part 1.2 EU level summary findings

Our analysis estimates the overall AAL to EU agricultural production from drought, hail, frost and excess rainfall at approximately EUR 28.3 billion, with over 60% for crops and the balance for livestock losses.

By 2050, the overall AAL is expected to rise **42-66% increase in annual average crop losses** depending on the emissions scenario. Crop AALs are estimated to increase from **EUR 17.4 billion** to **EUR 24.8 billion** under a medium emissions scenario (SSP2-4.5) and **EUR 28.9 billion** under a business-as-usual emission scenario (SSP 5-8.5). If related livestock losses are included, it is foreseeable that EU-27 AALs will reach **EUR 40 billion** by mid-century, as can be seen in Figure 1. These EU-wide averages incorporate significant variations by region, crop and peril.

The significant growth in losses revealed by increasing AALs indicates continued upward pressure on premiums and affordability for crop and livestock insurance across the EU in the coming decades. This analysis indicates that climate change will increase AALs for EU yields by approximately 2% per year.

Figure 1: Combined Crop and Livestock Annual Average Losses at EU level from Drought, Frost, Hail and Rain. Present Day and 2050 (SSP2-4.5 & SSP5-8.5). Includes AALs associated with product transformation services.



Source: Authors.

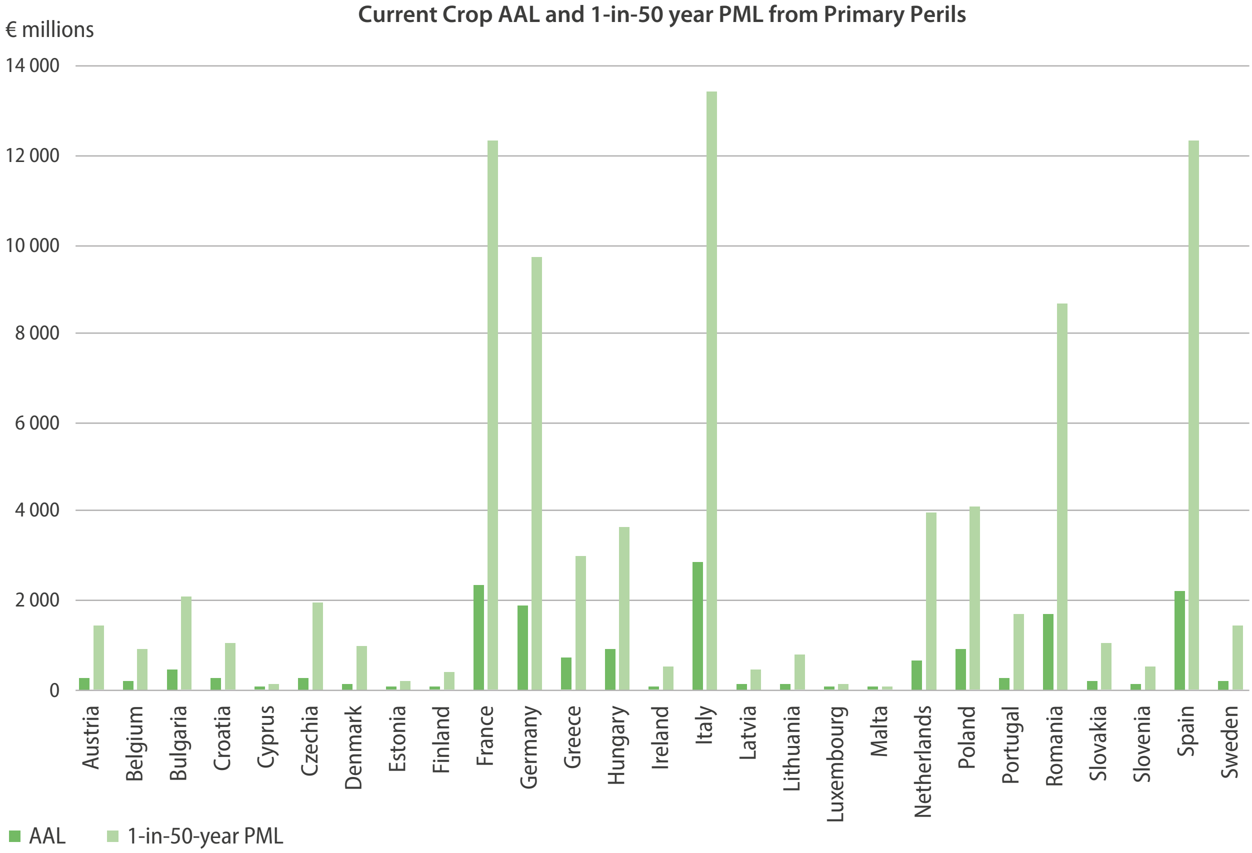
While these overall risk estimates include livestock (please see Annex II for methodology), our detailed analysis, from this point, focuses on climate impacts to crop production only.

Current and Future Expected Crop Losses

Present Day

Current combined crop AAL from drought, hail, frost and excess rainfall across the EU-27 is approximately **EUR 17.4 billion.** This is about 6.4% of EU-27 crop production. Most years will have overall losses below this figure and some will exceed it.

Figure 2: Current crop AAL and 1-in-50-year (2% annual probability) PML estimates from drought, frost, hail and rain.



Source: Authors.

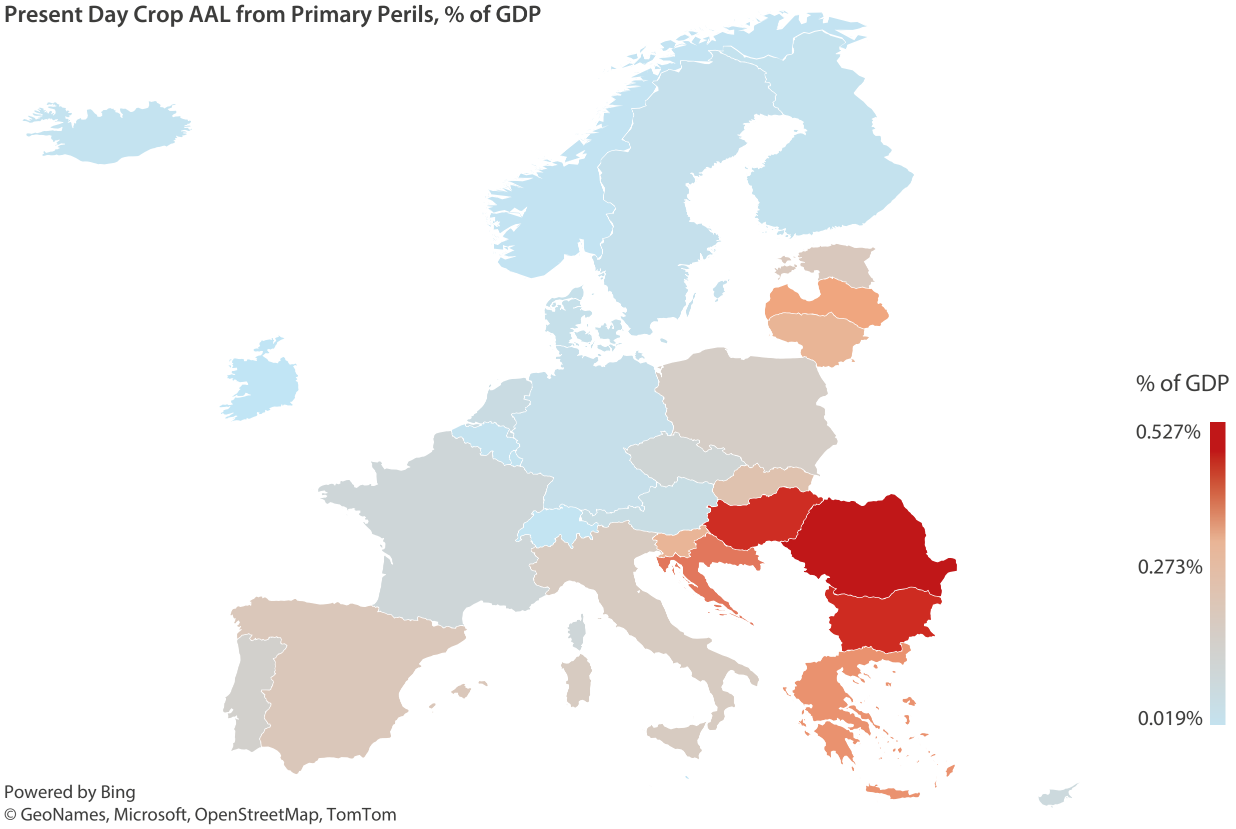
Aggregate EU loss estimates mask significant variations across Members States and regions. Figure 2 shows the distribution of the EUR 17.4 billion AAL, illustrating the annual expected losses across all crops from primary perils. The largest EU agricultural systems demonstrate the largest absolute risk with Germany, France, Italy and Spain estimated to lose, **on average EUR 2-3 billion**, every year. However, many smaller economies may have much higher proportional risks.

The current combined crop PML for the EU-27 in a catastrophic year (2% annual probability) is estimated EUR 35.1 billion (approximately double the AAL). For comparison, the extreme 2022 European drought has been estimated to have caused some EUR 25-30 billion of crop losses (excluding livestock) across Member States[3].

The expected increase from AAL to PML is much larger at a national level without the diversification of the EU-27. In general, catastrophic events produce losses of around four to five times the AAL. Figure 2 shows the crop multi-peril PML expected in each country, on average, once every 50 years (2% annual probability) compared to the AAL.

Italy, Spain and France all expect 1-in-50-year catastrophic agricultural losses exceeding EUR 12 billion. Some smaller and less developed economies face potentially larger impacts to their agriculture and rural areas.

Figure 3: Current Crop AAL as a % of total GDP.



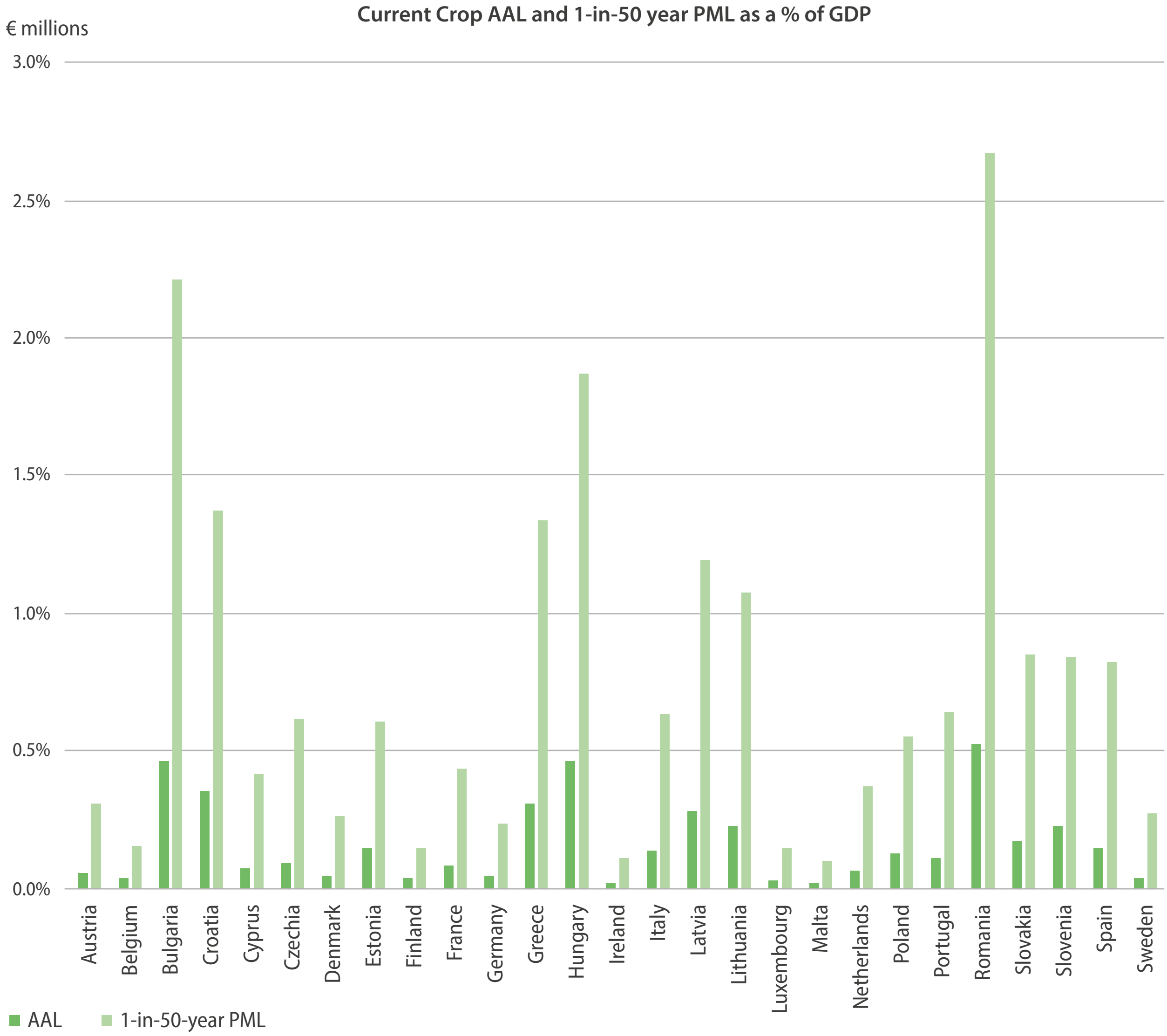
Source: Authors.

3 Pinke, Z., Ács T., Kalicz, P., Kern Z,. Jambor., A (2024) Hotspots in the EU -27 and Economic Consequences of the 2022 Spring-Summer Drought.

Meaningful comparison of AALs between Member States is enhanced when combined with GDP. Member States in south-eastern and central Europe may face relatively higher economic risks compared to other regions. Romania's AAL is approaching EUR 2 billion, similar to Germany with a much larger economy, while Hungarian farmers could be struck by AALs of almost EUR 1 billion, a relatively high figure compared to its GDP.

Figure 4 depicts the current annual expected losses to crop production as a percentage of national GDP, as well as extreme losses. Romania has an estimated 1-in-50 PML of nearly EUR 9 billion. Greece, Poland and Hungary all have PMLs of EUR 3-4 billion. Seven Member States currently risk losses to crop production of more than 1% of GDP from extreme events (2% annual probability).

Figure 4: Current Crop AAL and 1-in-50 year PML as a % of GDP.



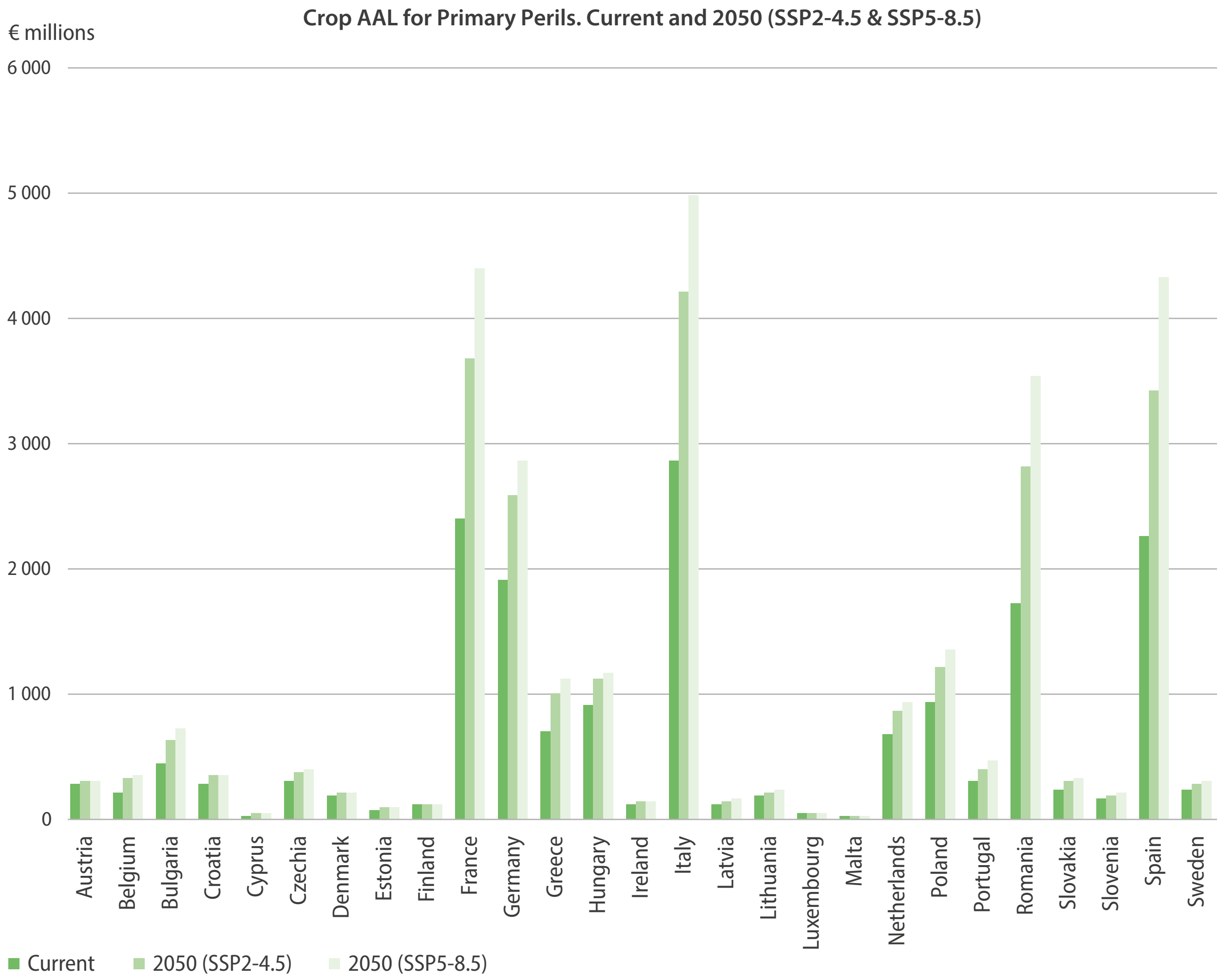
Source: Authors.

Future Climate Projections

Crop AALs are estimated to increase by between **42-66% from EUR 17.4 billion** to **EUR 24.8 billion** under a medium emissions scenario (SSP 2-4.5) and **EUR 28.9 billion** under a business-as-usual emission scenario (SSP 5-8.5). If related livestock losses are included, it is foreseeable that EU-27 AALs could reach **EUR 40 billion** by mid-century. These EU-wide averages mask much higher increases for some exposed crops and regions.

Future changes in aggregate crop losses produce greater variations across Member States. The largest absolute increases of over EUR 1 billion are expected in France, Spain, Italy and Romania. Romania is also expected to experience the largest relative change in crop AALs with an increase of 64%. In addition, Belgium, France and Spain are all also expected to see a significant growth in losses, on average, by over 50%.

Figure 5: Agricultural Crop AALs, present day and 2050 (SSP2-4.5, SSP5-8.5).

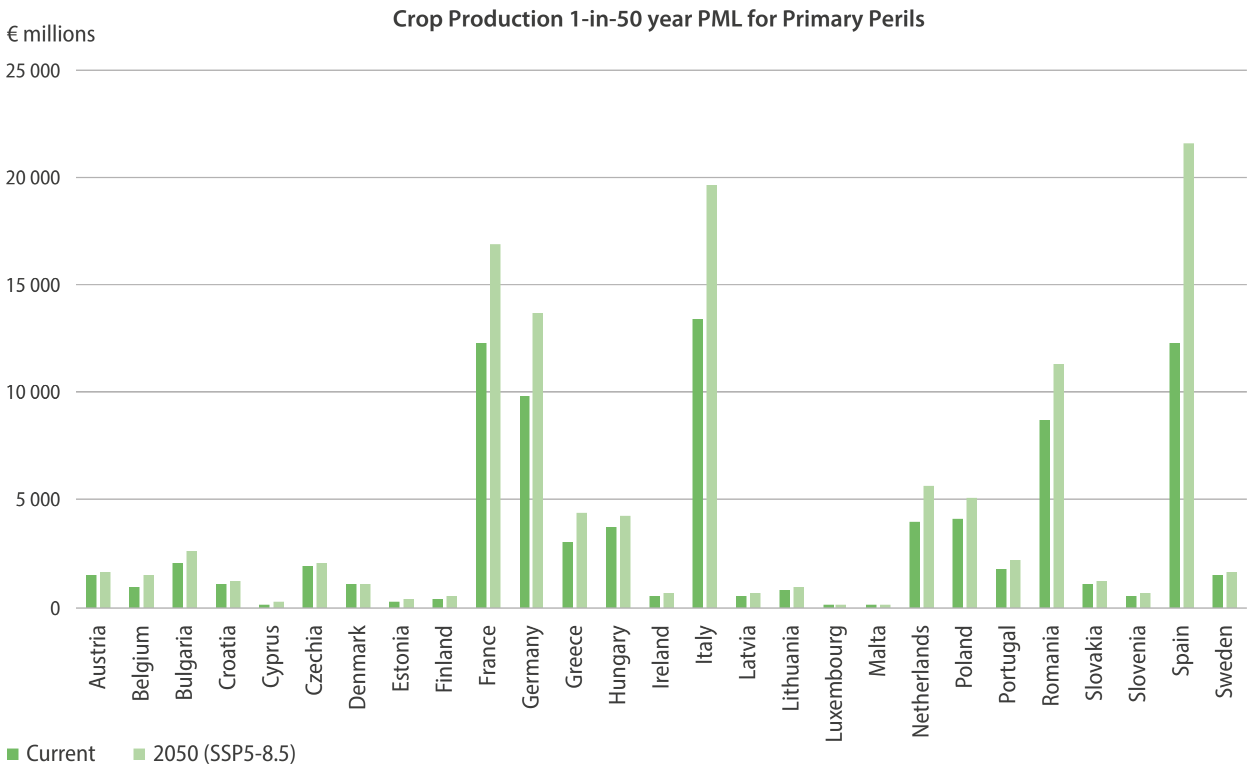


Source: Authors.

2050 EU Crop PML is expected to increase by between **45-63%** under medium emissions and business-as-usual emissions scenario, to **EUR 51 – EUR 57 billion** respectively. With related livestock losses this could foreseeably rise above **EUR 90 billion**.

Aggregate increases in PML at the EU level mask even greater relative changes at the national level. Some Member States may experience extreme losses up to 74% greater than now. For example, drought exposed Spain, Italy and France could see the largest absolute changes in losses during extreme years in future (see Figure 6).

Figure 6: Agricultural Crop 1-in-50-year PML. Present day and 2050 (SSP5-8.5).

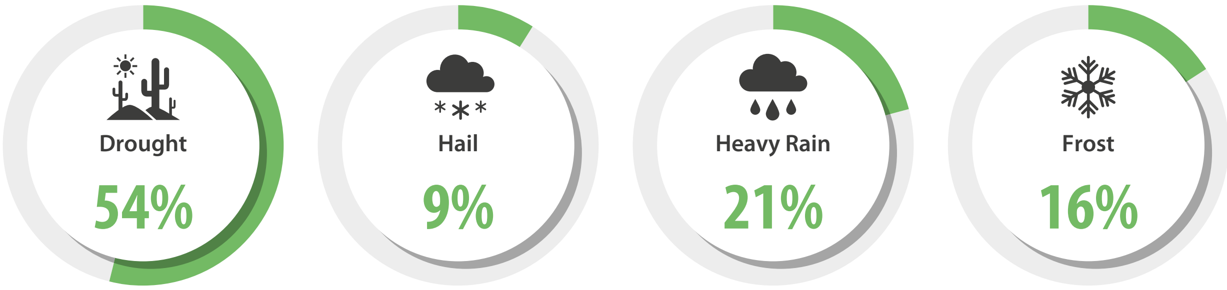


Source: Authors.

Current Patterns and Levels of Risk by Peril and Crop

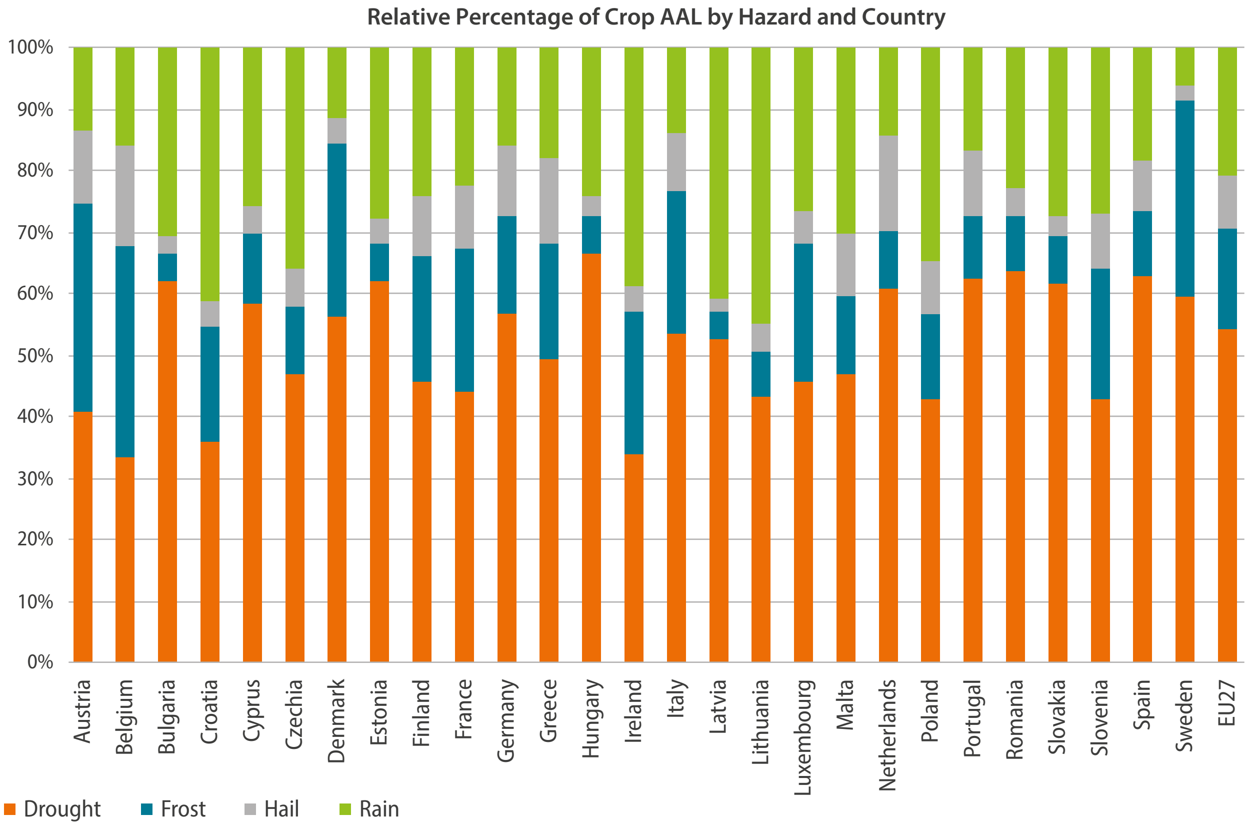
Aggregate EU losses mask varied losses across climate perils. **Drought, excess precipitation, hail,** and **frost** drive approximately 80% of agricultural losses across the EU. Of these, drought is the worst, causing an AAL across the EU of almost EUR 10 billion. Excess rainfall causes the next largest losses, totalling around EUR 3.2 billion, with frost and hail together contributing a similar amount.

Figure 7: EU primary perils for total crop AALs, Present Day.



Source: Authors.

Figure 8: Relative Percentage of Crop AAL by Hazard and Country.



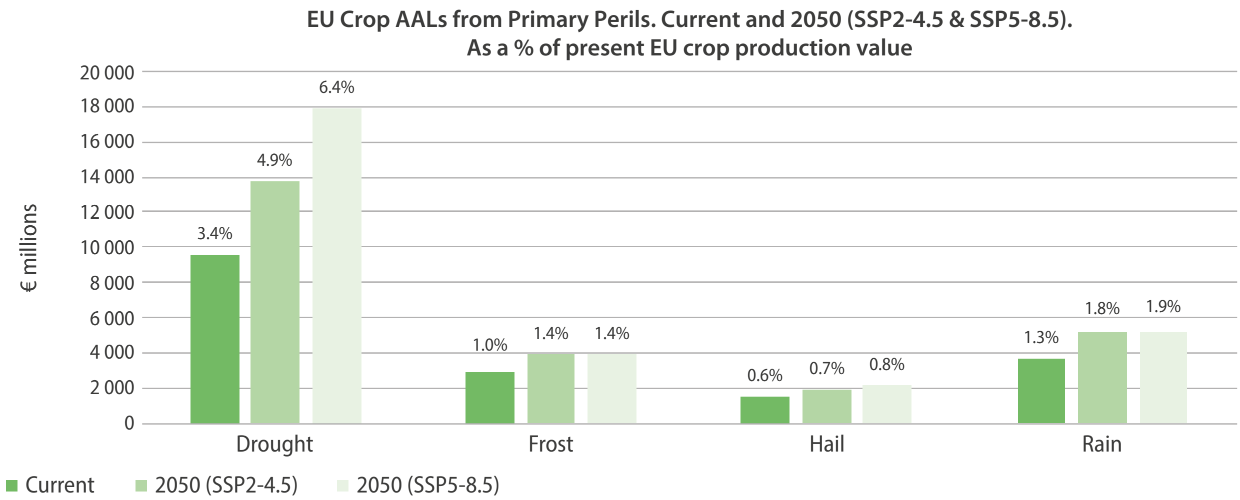
Source: Authors.

The risk modelling also illustrates the balance of primary perils across Europe. Drought (soil moisture deficit) dominates, causing around 60% of overall losses in many southern and central EU countries. Even in northern and maritime western regions, drought drives 1/3 of expected losses. Overall, frost and excess rain produce a similar proportion of EU agricultural losses, but the patterns for these vary significantly across the EU driven by climate, geography and crop distribution. Hail, the peril most widely associated with insurance protection, generates a relatively small proportion of overall EU agricultural losses.

Into the future, losses from the primary perils are expected to increase at varying rates. Drought risk continues dominating at the EU level, driving half of overall expected losses or much more depending on the emission pathway: 44% and 87% under scenarios SSP2-4.5 and SSP5-8.5 respectively by 2050.

Expected variation across future climate change scenarios is also high for hail, with AAL increases of 23% under SSP2-4.5 and 40% under SSP5-8.5. AALs from frost and rain events are expected to increase by similar amounts under both emissions scenarios.

Figure 9: EU Crop AALs from Drought, Frost, Hail, Rain (absolute and as a % of EU present total EU crop production value). Present Day and 2050 (SSP2-4.5 & SSP5-8.5).



Source: Authors.

Part 1.3 Current and future trends of the four primary perils across EU member states

Drought

The droughts and associated heatwaves of 2003 and 2022 produced the most extreme losses to EU agriculture in recent history.

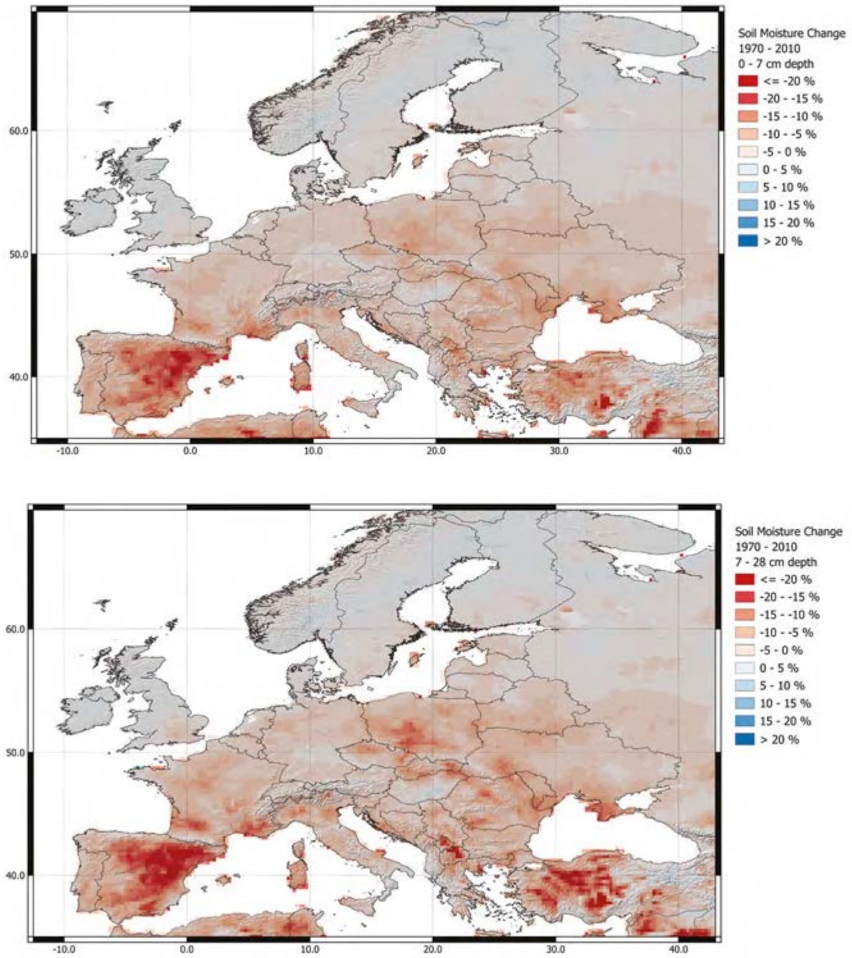
The 2003 heatwave and severe drought significantly reduced crop yields with farmers across the EU losing an estimated EUR 11.6 billion[4]. In France, maize production fell by 27% and wheat by 20% compared to the previous year with fodder collapsing by 60%. Italy's agricultural sector was similarly devastated, losing 25% of its maize production and 40% of its fodder. Both countries faced financial impacts exceeding EUR 4 billion.[5]

4 Santos, J., Pulido-Calvo, I., Portela, M. (2010) Spatial and temporal variability of droughts in Portugal.
5 United Nations Office for Disaster Risk Reduction (UNDRR). (2003). Early warning of European heatwaves.

The drought of 2022 reduced maize yields by 24% across Europe compared to the previous year. Spain bore the largest proportion of the losses with other countries, including France, Italy, and Romania severely affected.[6]

Since the 1960s, average soil moisture, an important drought indicator, has dropped significantly in most of Europe and increased the need for artificial irrigation (see Figure 10). For central European countries, the upper soil layer of 0-7cm, experienced a drop of about 2-4% on average, while most of the Iberian Peninsula lost 5-15% of its moisture. Only parts of Ireland and Scandinavia saw a slight increase in moisture. For deeper layers of soil, 7-28cm, the drop is even more pronounced with 4-10% on average for central Europe, 5-15% for France and up to 25% for Spain. The drop in soil moisture can be linked to climate effects and depleted ground water resources. However, higher temperatures combined with reduced natural irrigation due to a changing climate add further pressure to ground water resources.

Figure 10: Change in soil moisture for 0-7cm (map above) and 7-28cm (map below) soil depths, %. 1970 vs 2010.

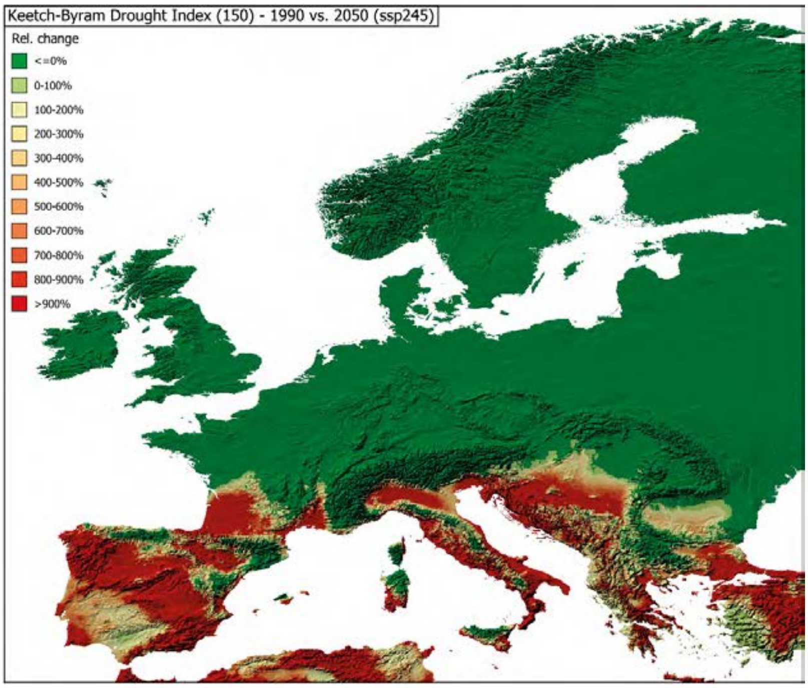


Source: Authors.

The Keetch-Byram Drought Index assesses drought conditions and wildfire risk using multiple meteorological factors, including maximum temperature and precipitation. By 2050, the most severe increase in drought risk is expected in Spain, Italy and Greece with more than nine times as many days of severe drought conditions each year, under the SSP2-4.5 warming scenario compared to 1990. Most of southern Europe is at higher risk of more severe drought days relative to the current climate (see Figure 11).

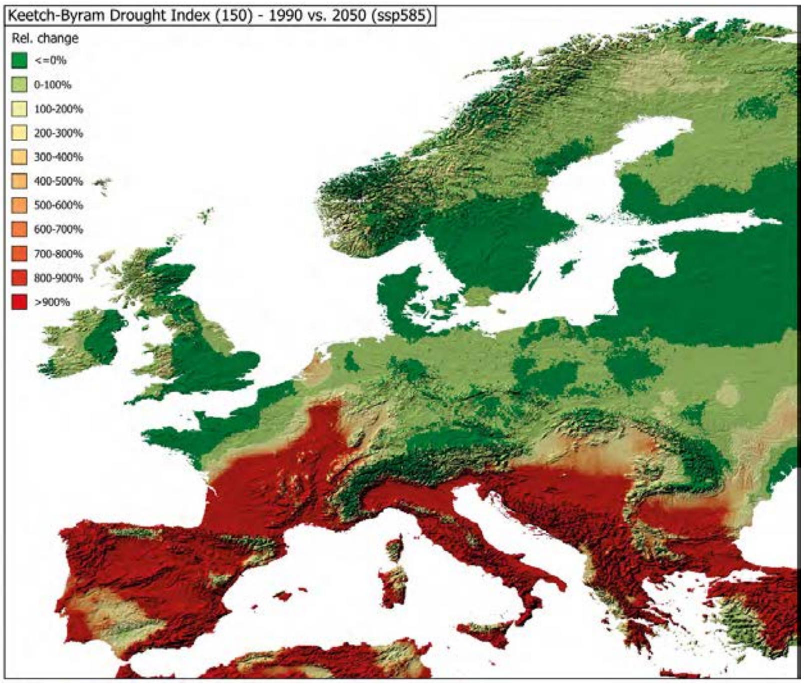
6 Brown, P., & Williams, L. (2023). Climate change and agricultural resilience: A case study of EU policy shifts.

Figure 11: Relative Change in Number of Days with Keetch-Byram Drought Index > 150. 2050 vs. 1990. SSP2-4.5.



Source: Authors.

Figure 12: Relative Change in Number of Days with Keetch-Byram Drought Index > 150. 2050 vs. 1990. SSP5-8.5.



Source: Authors.

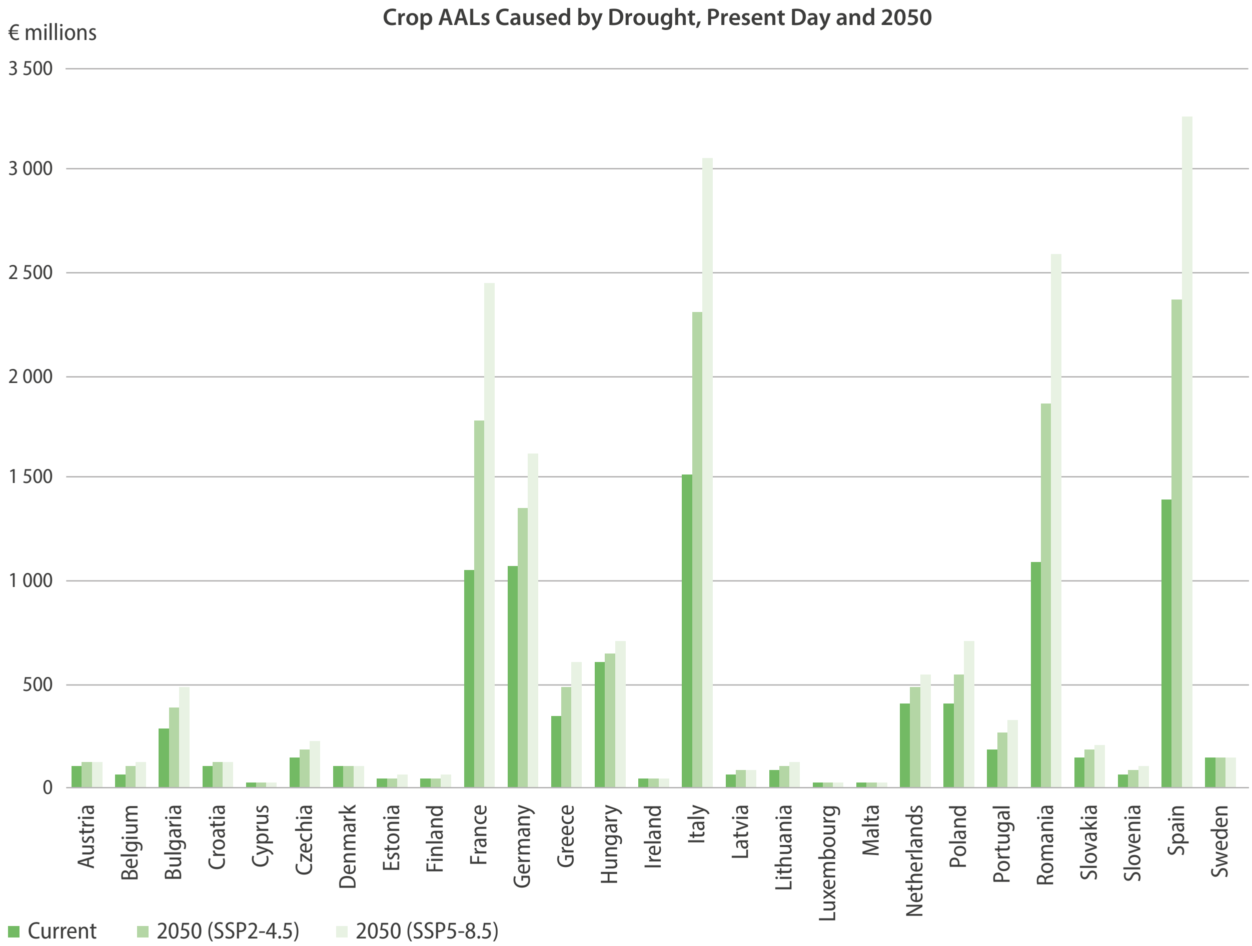
Current crop AALs from drought exceed 3% of EU crop yield and are valued at EUR 9.4 billion. The largest agricultural producers (Spain, Italy, France, Romania and Germany) have AALs in excess of EUR 1 billion (see Figure 13). Current 1-in-50 year PMLs are 5-12 times greater than the average, reaching almost EUR 8 billion in Romania, EUR 9 billion in Germany and over EUR 10 billion in France, Spain and Italy.

By 2050, under the SSP2-4.5 scenario EU crop AAL from drought is expected to increase by 46% to almost EUR 14 billion, some 5% of current production values, with Spain experiencing the largest absolute increase in AAL.

Under the SSP5-8.5 scenario EU crop AAL from drought could increase by 87% to almost EUR 17.9 billion, representing over 6% of current production value.

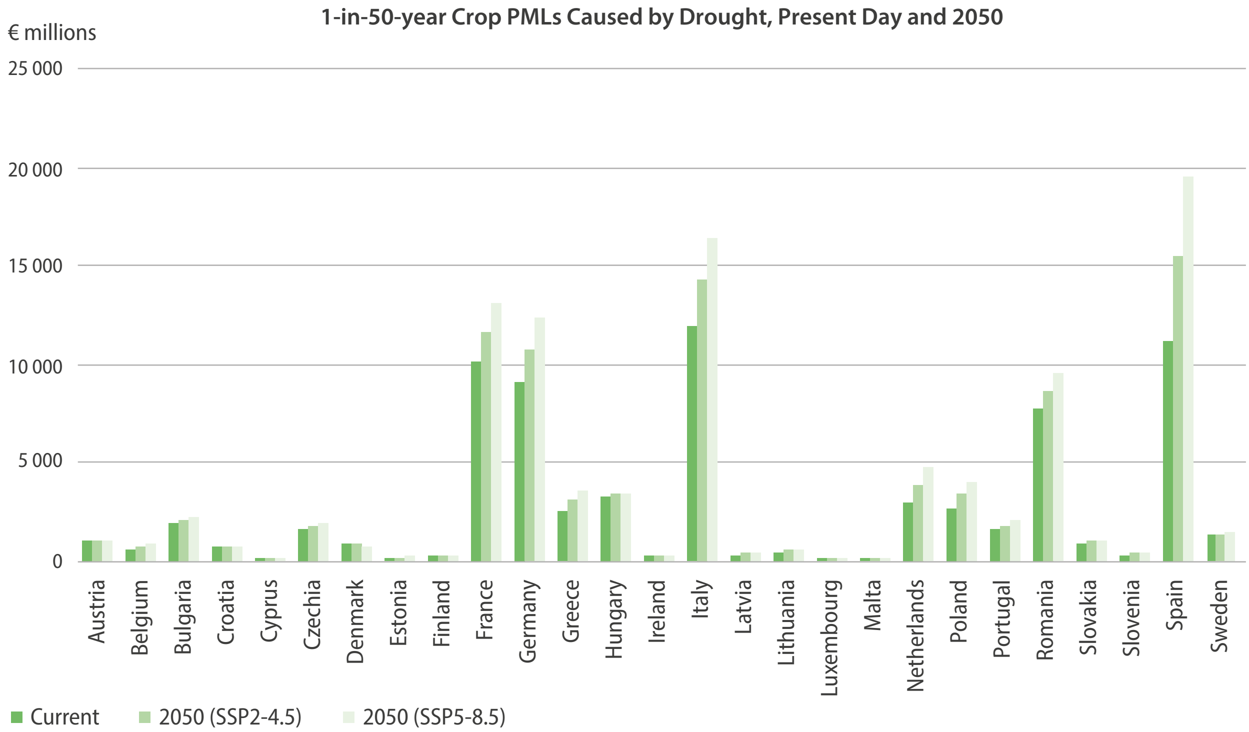
There is a less pronounced growth trajectory for 1-in-50 extreme years in most countries, though expected losses nearly double in Spain to approximately EUR 20 billion (see Figure 14).

Figure 13: Crop AALs Caused by Drought, Present Day and 2050 (SSP2-4.5 & SSP5-8.5).



Source: Authors.

Figure 14: 1-in-50-year Crop PMLs Caused by Drought, Present Day and 2050 (SSP2-4.5 & SP5-8.5).



Source: Authors.

Frost

Frost risk dynamics present a complex pattern across the EU and, perhaps counterintuitively, show significantly growing losses despite warming trends.

Frost poses significant threats to high value crops such as viticulture, fruit and vegetables which are highly sensitive and vulnerable during flowering and shortly after budding. In 2017, a single frost in mid-April led to 24% and 12% less apple and pear production respectively in Europe.[7] Total losses were EUR 3.3 billion with approximately EUR 600 million insured. Italy and France were estimated to have the highest losses, at approximately EUR 1 billion.[8]

Under current climate conditions in Europe, there is already significant exposure to late frosts (between March and May). In 2021, a sequence of severe late-spring frosts led to 50-70% less production for some crops.[9] In France, the late spring frosts affected olive groves, causing a 25-30% reduction in production.[10] These also affected approximately 80% of vineyards, causing a 25% reduction in wine production.[11] In total, the frosts in spring 2021 caused EUR 3 billion of damage in the agricultural sector.[12]

7 Garcia, M., & Lopez, T. (2022). Advancements in crop yield prediction using remote sensing techniques.
8 Munich Re. (2018). Spring frost losses and climate change.
9 Fruit Journal. (2022, September 30). Gelate tardive: come mitigare i danni?
10 Olive Oil Times. (2021). Producers assess damage of springtime frost across Southern France.
European Natural Hazards Research Group. (2023). Economic and environmental impacts of extreme weather events in Europe.
11 Decanter. (2023). Fears of frost damage in French vineyards.
12 Devastating Frost in Bordeaux Up to 90% of Some Vineyards Damaged TheWineCellarInsider. (2017) Devastating Frost in Bordeaux Up to 90% of Some Vineyards Damaged.

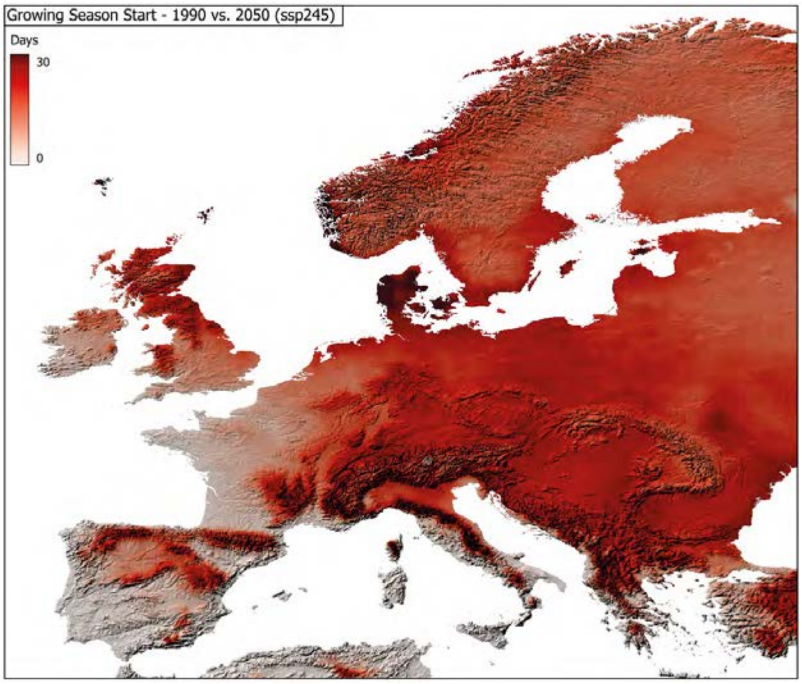
In April 2017, approximately one third of Bordeaux wine production was lost due to a late frost with some vineyards 90% destroyed.[13]

Climate change is creating additional exposure to crops even earlier in the growing cycle, as biological spring tends to arrive earlier than in the 1970s. Frost days, however, have not shifted in the same way. The average number of frost days during the early growing stages was 0.5 - 1 day in Central Europe fifty years' ago. This has increased to nearly three frost days now. In France, the average annual frost days in growing periods has doubled, approaching five in some regions. Frost days in Spain have moved regionally, decreasing in central and southern Spain, while increasing in northern Spain.

These trends will continue to 2050 with growth periods starting earlier in the year, putting crops at greater risk of being impacted by spring frosts when the sun is weaker and exposure to colder northerly winds is greater.

This will affect most of central, eastern and northern Europe and parts of northern Spain, where growing periods are expected to start approximately 20 days earlier (see Figure 15). Altitude and aspect are major factors. For example, in the Apennine Mountains, the growing season is projected to start an entire month earlier.

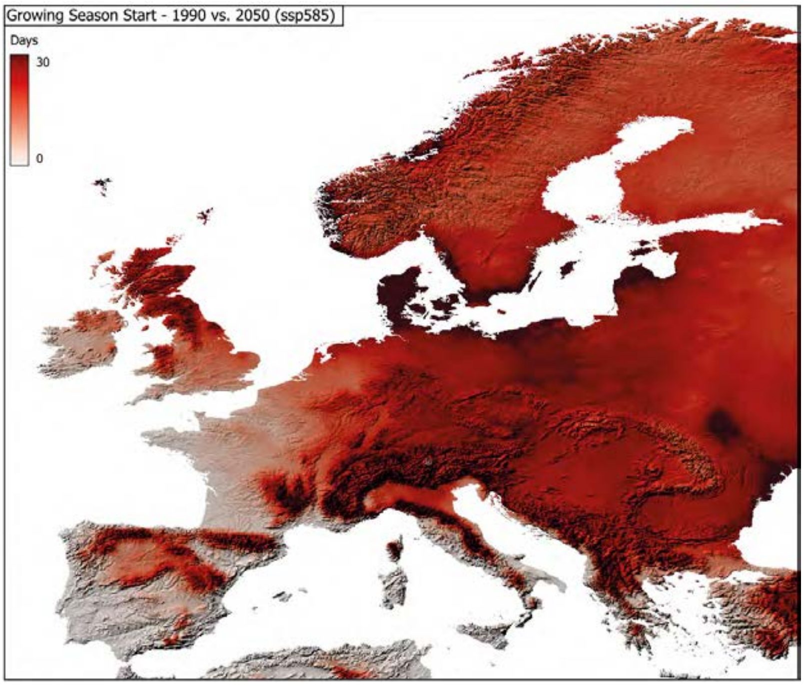
Figure 15: Change in Growing Season Start - 1990 vs. 2050 SSP2-4.5.



Source: Authors.

13 The Wine Cellar Insider. (2017) Devastating Frost in Bordeaux Up to 90% of Some Vineyards Damaged.

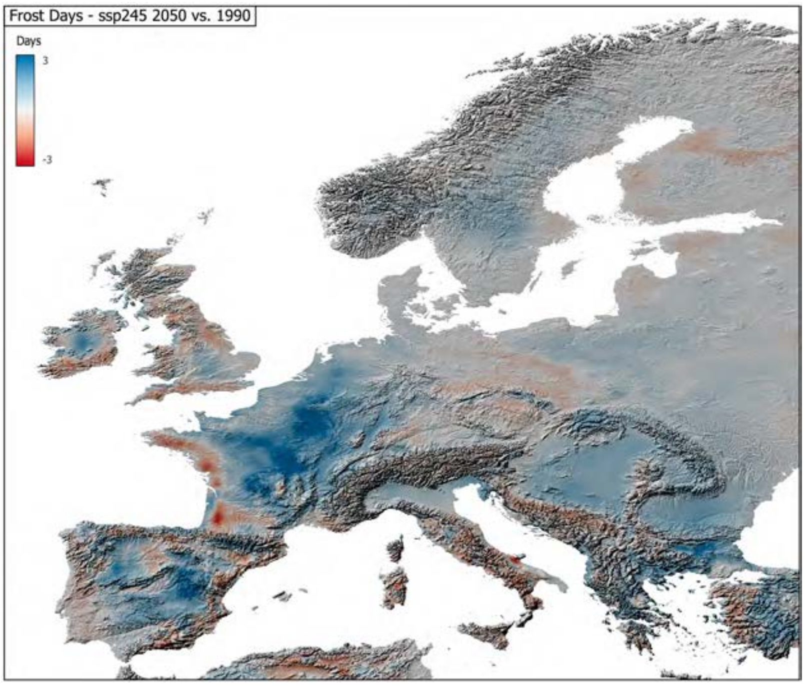
Figure 16: Change in Growing Season Start - 1990 vs. 2050 SSP5-8.5.



Source: Authors.

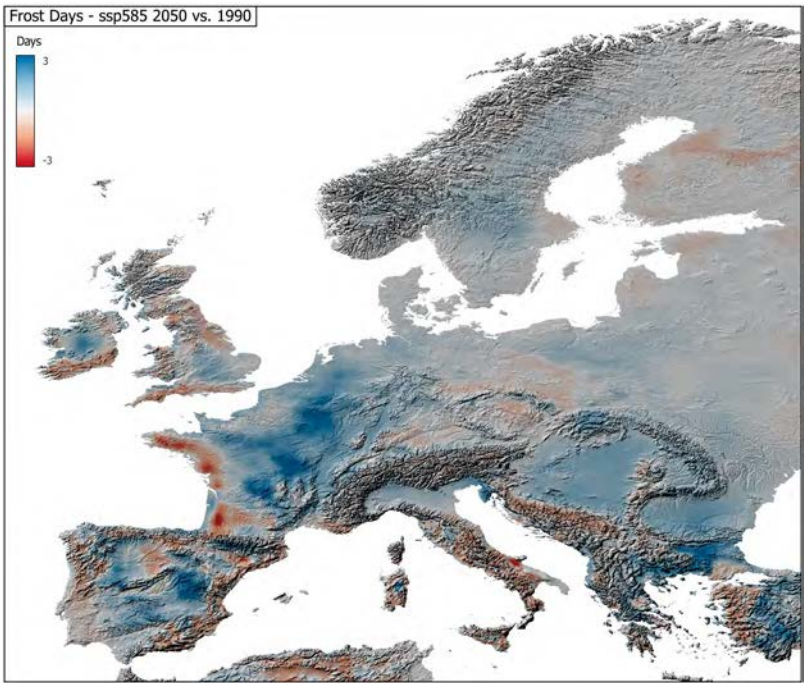
Future frost loss trends across the EU will be diverse. Climate models suggest the number of frost days during the growing season will increase up to 2050 especially in France, Belgium, the Netherlands and Central Spain with up to four additional frost days compared to the 1990s (see Figure 17). However, in Poland, Czechia and parts of Italy the number of frost days may decline. The coastal parts of Spain and western France (especially Brittany and Nouvelle-Aquitaine) will also experience up to three less frost days.

Figure 17: Change Number of Frost Days during growing season 1990 vs. 2050. SSP245.



Source: Authors.

Figure 18: Change Number of Frost Days during growing season 1990 vs. 2050. SSP5-8.5.



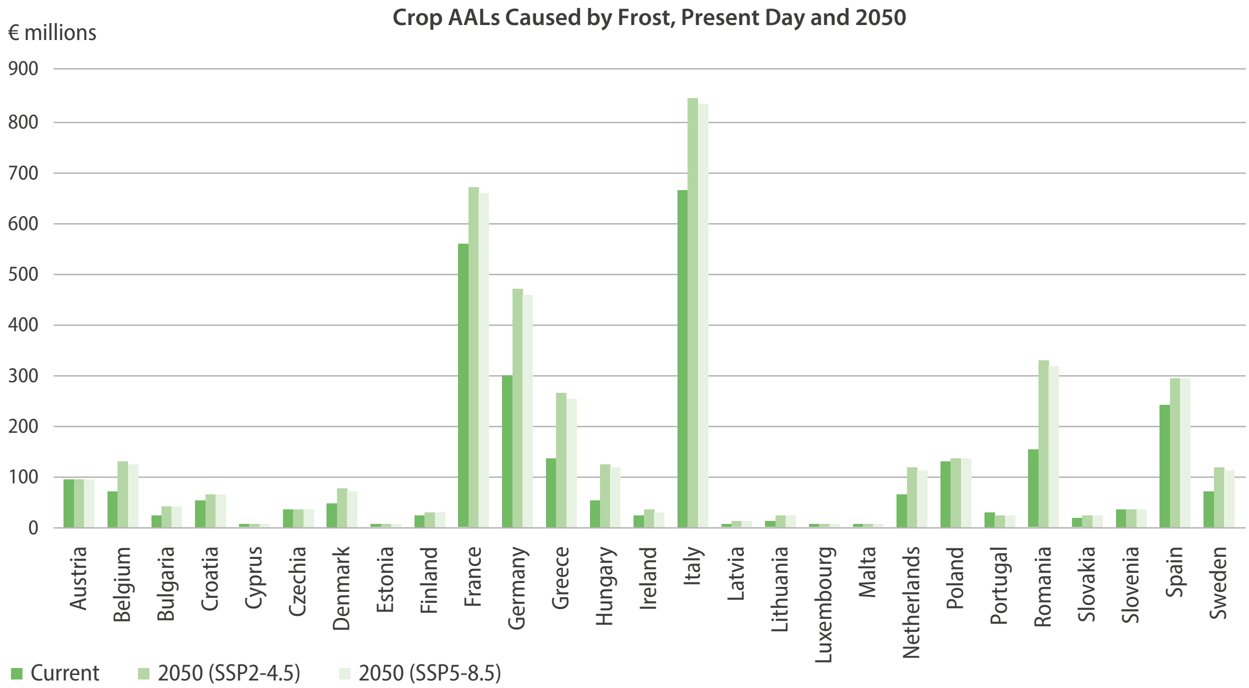
Source: Authors.

Current EU AAL from frost is around 1% of crop yield, or some EUR 2.8 billion. In Italy and France, AALs exceed EUR 500 million (see Figure 19). For a 1-in-50-year return period, losses in excess of EUR 1 billion are expected in Greece, Romania, France, Germany, Italy and Spain (see Figure 20).

By 2050, under the SSP2-4.5 scenario, EU crop AALs from frost are expected to increase by 40% to almost EUR 4 billion. Italy, France, Germany and Romania are expected to see the largest absolute increases. In relative terms, losses from extreme (1-in-50) years are expected to increase most in eastern Member States such as Bulgaria, Hungary and Romania to more than double by 2050. By 2050, under the SSP5-8.5 scenario, the EU crop AALs from frost are expected to be similar to the moderate scenario, increasing 36% to EUR 3.9 billion.

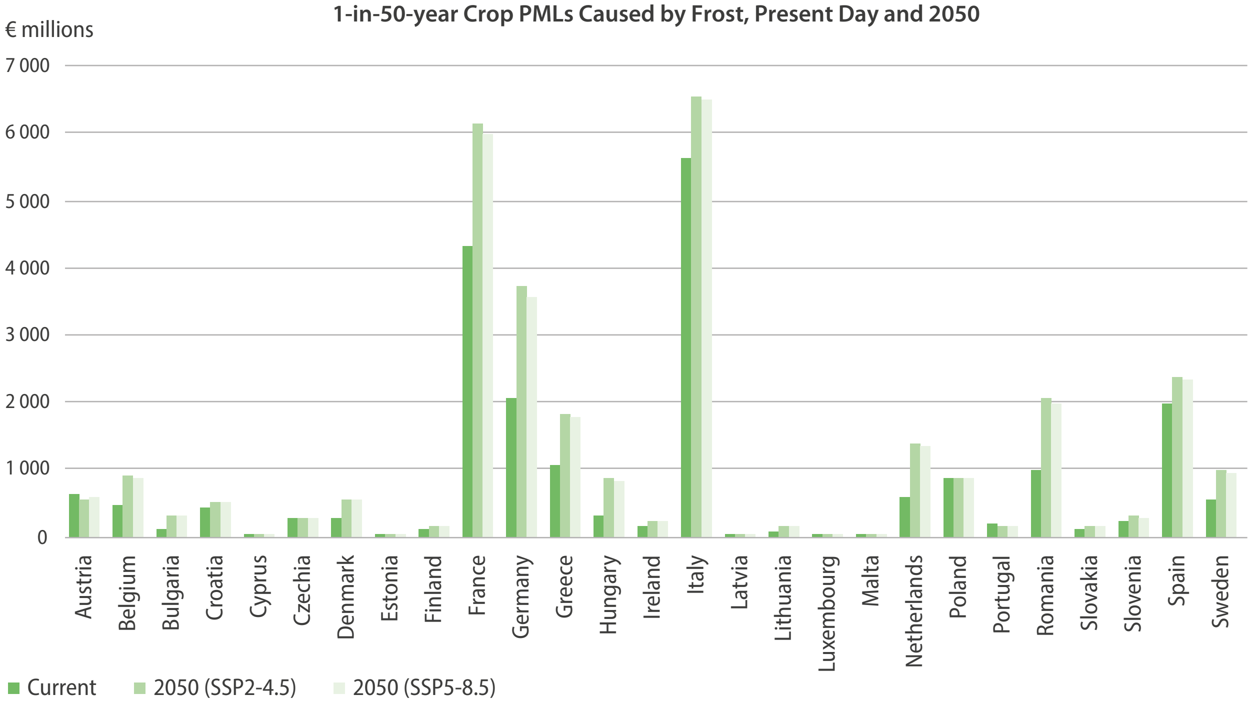
1-in-50 year PMLs for frost damage are expected to be between 5-9 times larger than member states annual expected losses. Losses are highest in Italy, which sees an individual PML of EUR5.6 billion. This is expected to increase by 17% under the SSP2-4.5 climate scenario (see Figure 20).

Figure 19: Crop AALs Caused by Frost, Present Day and 2050 (SSP2-4.5 and SSP5-8.5).



Source: Authors.

Figure 20: 1-in-50-year Probable Maximum Crop Losses Caused by Frost, Present Day and 2050 (SSP2-4.5 and SSP5-8.5).



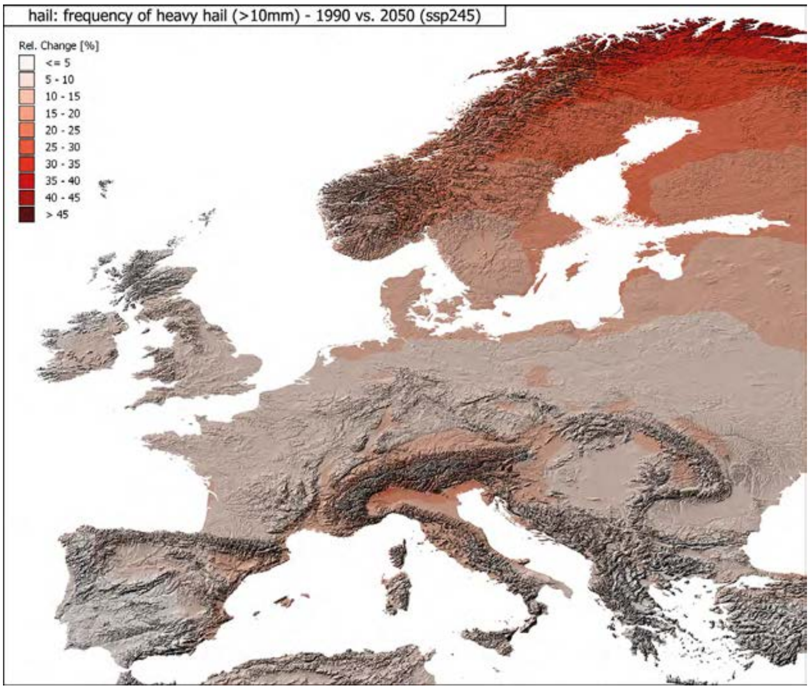
Source: Authors.

Hail

Although hailstorms are usually just a few kilometres wide, they can cause severe impacts to high value crops such as vines. For example, 1/3 of production was lost in the Bordeaux region of France in 2018 from a hailstorm in May which damaged over 13 000 ha of vines with approximately half entirely destroyed.[14] The SSP2-4.5 climate change scenario assumes global greenhouse gas emissions peak around 2040 and then decline, aiming for radiative forcing to stabilise at 4.5 watts per square meter by 2100. Under this scenario, the frequency of heavy hail events is expected to increase by 15-20% for large areas in the Mediterranean and south-central Europe including areas in southern Germany, Austria, Croatia, Serbia and Romania (see Figure 21). The Baltic coast will see a similar increase, while northern Scandinavian regions will see the starkest increase in hail exposure, though vulnerable agricultural activity is limited in this region.

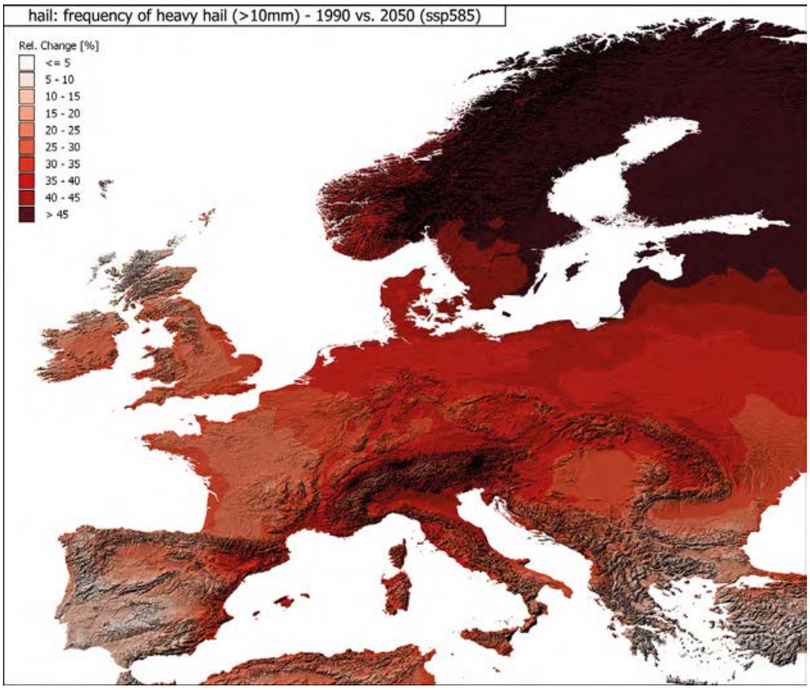
14 Hail damages 17,000 hectares of vines.
Liv-ex. (2018). Hail in Bordeaux: Damage in context.

Figure 21: Change in frequency of heavy hail (stone diameter >10mm) 1990 vs. 2050. SSP2-4.5.



Source: Authors.

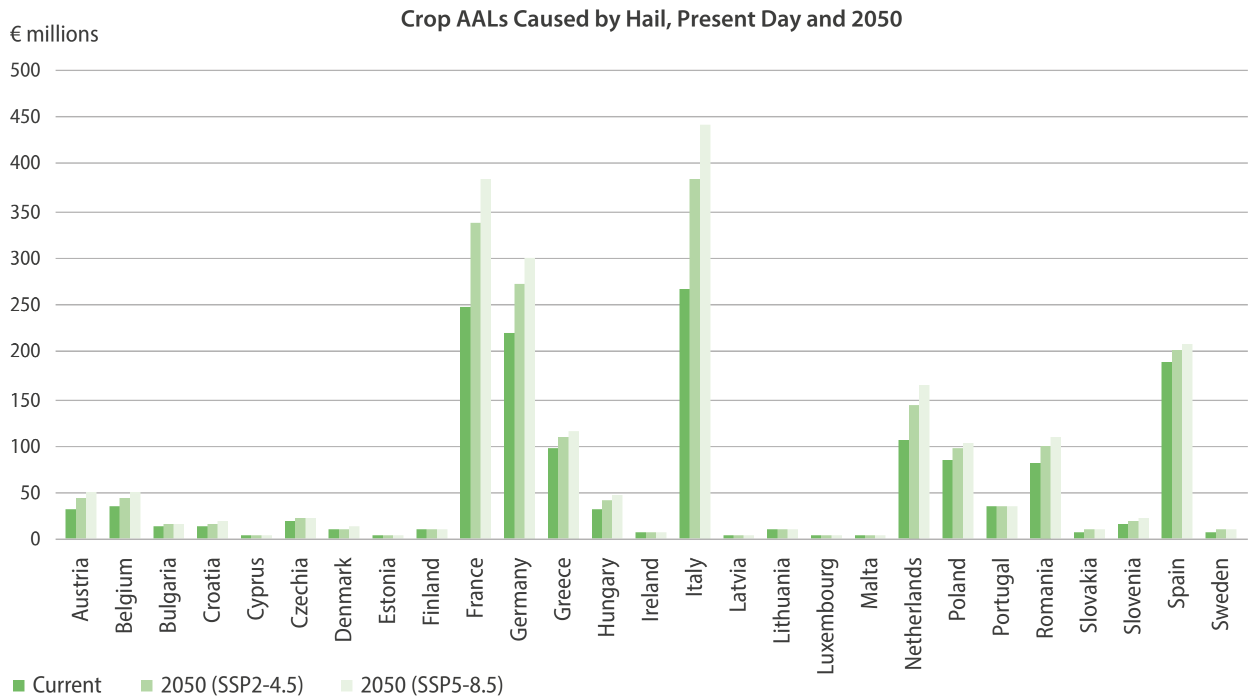
Figure 22: Change in frequency of heavy hail (stone diameter >10mm) 1990 vs. 2050. SSP5-8.5.



Source: Authors.

Current total EU hail AAL is over EUR 1.5 billion, or 0.6% of crop production value, led by France with an AAL of EUR 250 million. By 2050, under the SSP2-4.5 scenario, EU crop AAL is expected to increase to over EUR 1.9 billion, with the largest absolute increases in Italy, France and Germany. In relative terms, Slovenia is also expected to see an increase in hail losses of 41% (see Figure 23). By 2050, under the SSP5-8.5 climate change scenario, EU crop AAL from hail would increase by 40% to over EUR 21 billion, 0.8% of current production value, similar to the moderate climate change scenario. Under the SSP-8.5 scenario, Italy would see an AAL increase to EUR 440 million, while, France would see an increase to approximately EUR 380 million.

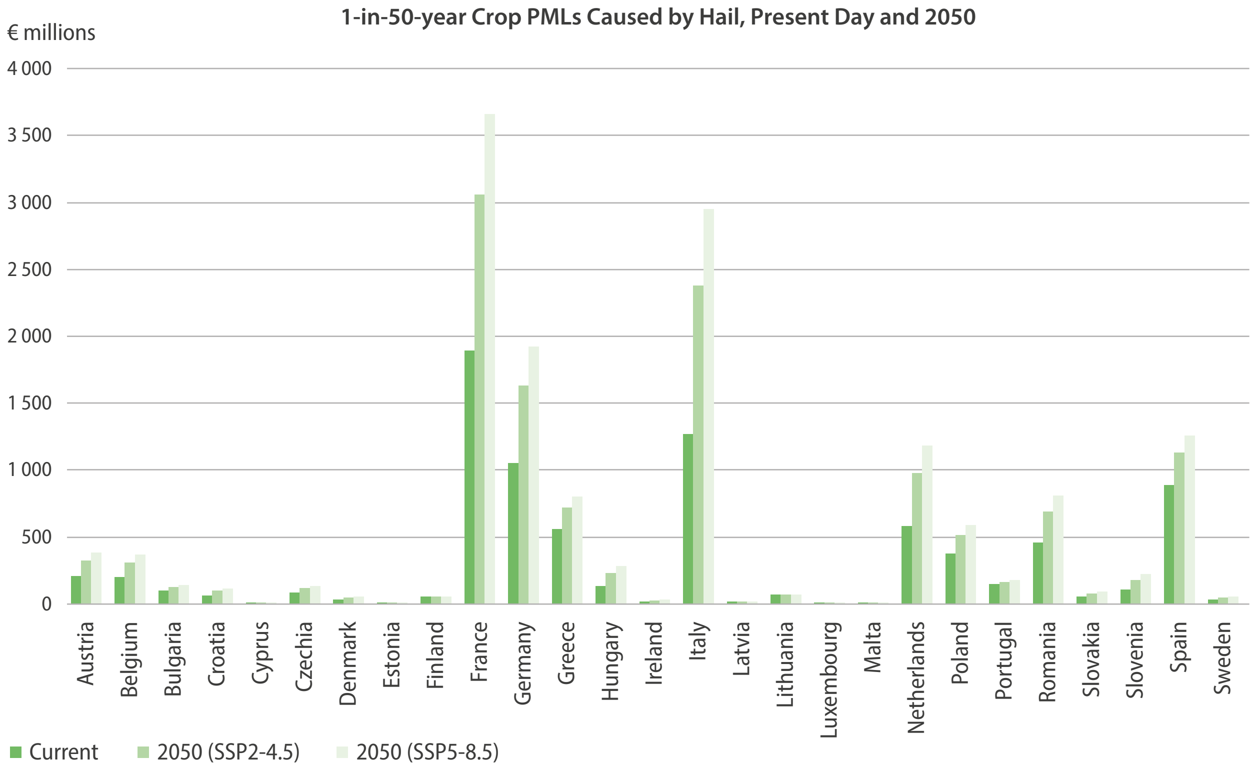
Figure 23: Annual Average Crop Losses Caused by Hail, Present Day and 2050 (SSP2-4.5 & SSP5-8.5).



Source: Authors.

1in-50 year PMLs for hail damage are expected to be between 5-9 times larger than member states annual expected losses. Losses are highest in France, which sees an individual PML of EUR 1.9 billion. This is expected to increase by 61% under the SSP2-4.5 climate scenario (see Figure 24).

Figure 24: 1-in-50-year Crop PMLs Caused by Hail, Present Day and 2050 (SSP2-4.5 & SSP5-8.5).



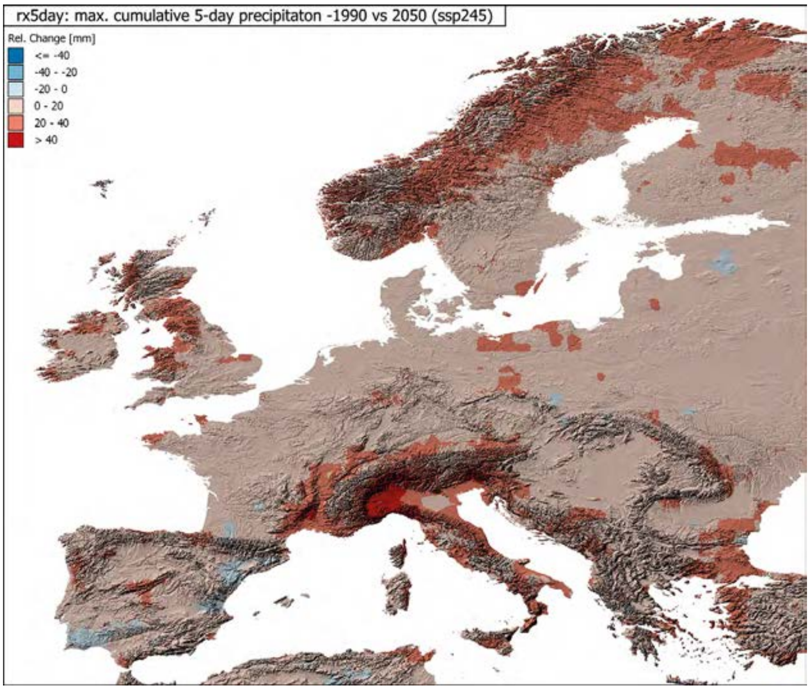
Source: Authors.

Excess Rainfall

In addition to damaging the quality and yield of crops, excess rainfall can also increase the spread of pests and disease, damaging higher value crops such as fruit and vines. Waterlogged and oversaturated soil can inhibit root growth, deprive plants of oxygen and delay sowing or harvesting. Excess rainfall has varied, and usually localised, impacts depending on timing, intensity and duration. Related flood risks vary also depending on landscapes and hydrology, making modelling of localised and aggregated impacts challenging (see Figure 25). It is possible, however, to draw dynamics of current and future risk patterns.

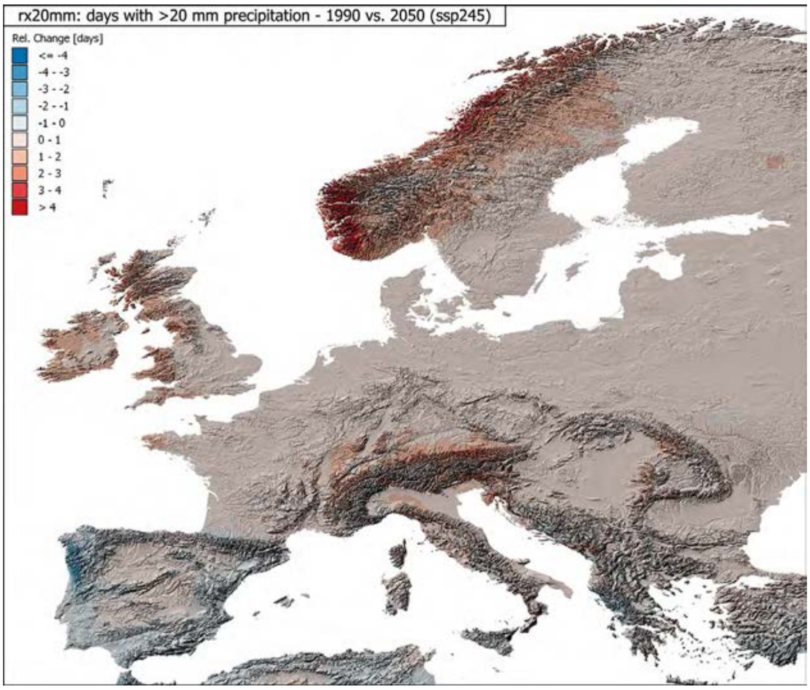
By 2050, under the SSP2-4.5 scenario, extreme precipitation events (measured by the maximum cumulative 5-day precipitation) are expected to increase by over 20mm in northern Scandinavia, Italy and Southern France, as well as south-eastern areas near the Mediterranean and the Black Sea.

Figure 25: Relative change in maximum cumulative five-day precipitation 1990 vs 2050 (SSP2-4.5).



Source: Authors.

Figure 26: Relative change in number of days with more than 20mm of precipitation, 1990 vs 2050 (SSP2-4.5).

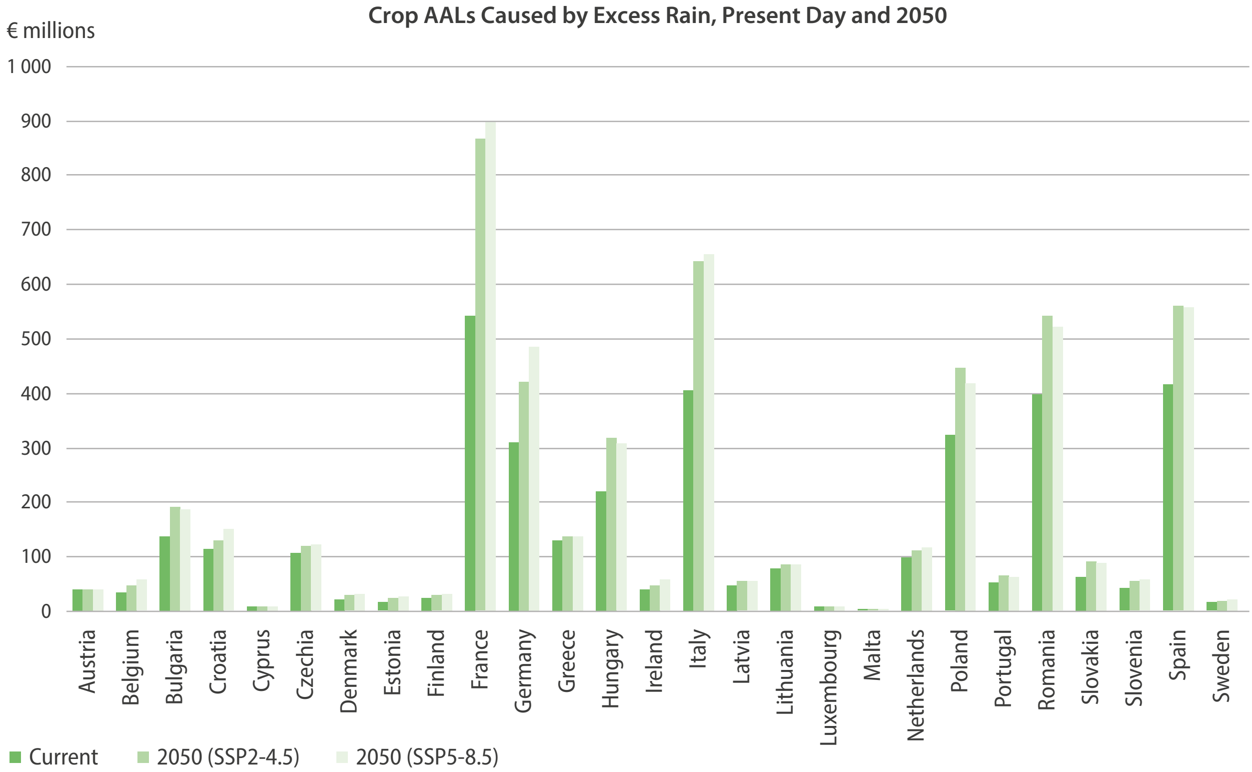


Source: Authors.

Current total EU excess rainfall AAL is approximately EUR 3.6 billion, with major agricultural economies losing up to EUR 500 million. Across the EU, excess rain AALs are expected to increase by nearly 40% up to 2050 under the SSP2-4.5 scenario, with the largest increases expected in Estonia, France, Italy and Slovakia (see Figure 27). By 2050, under the SSP5-8.5 scenario, EU crop AALs from excess rain could increase by 41% to almost EUR 15.1 billion, 6.4% of current production value, similar results to the more conservative emissions scenario.

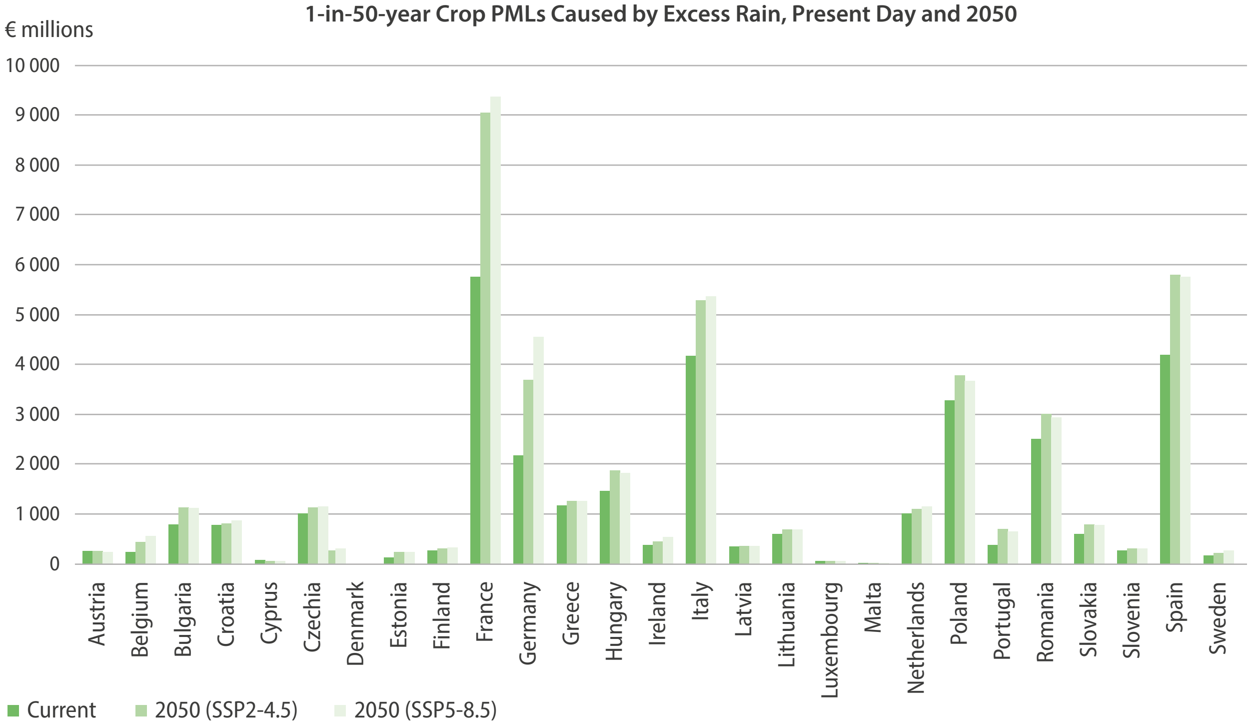
PMLs for a 1-in-50 year rainfall event vary significantly across Member States according to hazard and exposure distributions. France has the highest PML at nearly EUR 6 billion, increasing by nearly 60% by 2050 under the SSP2-4.5 scenario (see Figure 28).

Figure 27: Crop AALs Caused by Excess Rain, Present Day and 2050 (SSP2.4.5 & SSP5-8.5).



Source: Authors.

Figure 28: 1-in-50-year Crop PMLs Caused by Excess Rain, Present Day and 2050 (SSP2.4.5 & SSP5-8.5).



Source: Authors.

Part 2

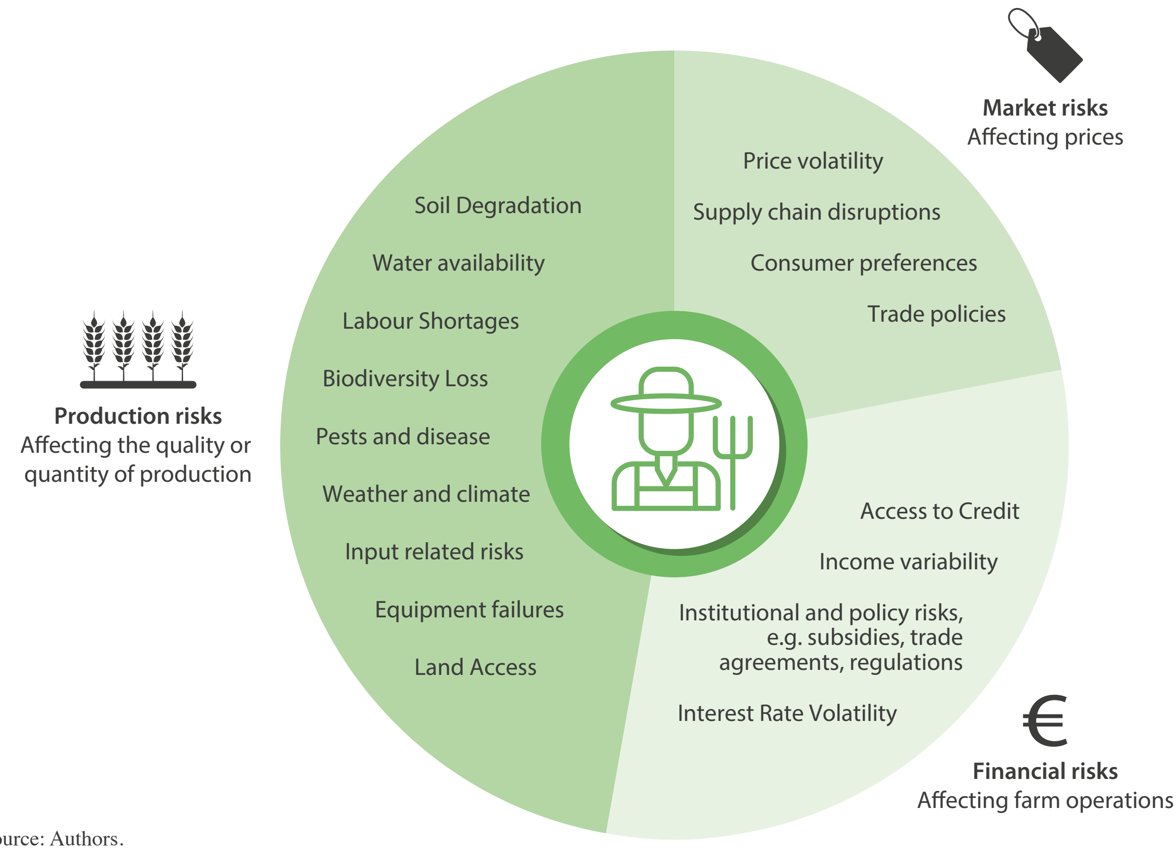
Overview and classification of EU agriculture insurance schemes

Part 2.1 Risk management tools in EU agriculture

Risk management in agriculture

Risk management is the process of identifying, analysing and reducing risks to decrease losses. The following types of risks affect agriculture, with climate influencing and in many cases amplifying all three categories:

Figure 29: Broad risk types faced by agricultural producers.



Source: Authors.

Climate change and its cascading effects have intensified the need for risk management in agriculture. Farmers and policymakers must navigate a more complex and extreme risk landscape. This involves proactive strategies to reduce risks, including adaptation, as well as preparation to optimise responses.

An effective agriculture risk management plan, from farm to government levels, is a multi-dimensional combination of all or some of the following tools:

- Risk identification and quantification;
- Farm level risk reduction through resilience and adaptation strategies;
- Risk transfer mechanisms, including insurance systems;
- Financial safety nets;
- Contract farming;
- Diversified income sources;
- Regional long-term resilience planning and investment.

While this report focuses on insurance systems, they are only part of the resilience and risk management picture. Agriculture risk management across the three categories of risks identified above requires multiple risk reduction interventions, including broader financial instruments.

EU farming enterprises, their financial risks and related insurance systems operate in the context of a well-established ecosystem with CAP and local variations across Member States.

Risk Management and Pillars of the CAP

CAP plays a central role in addressing financial risks for farmers. CAP was established in 1962 to ensure food security, stabilise agricultural markets and support rural development across the EU. With a series of reforms, CAP objectives have expanded to include environmental sustainability, addressing climate change risks and ensuring a stable income for farmers amidst fluctuating circumstances.

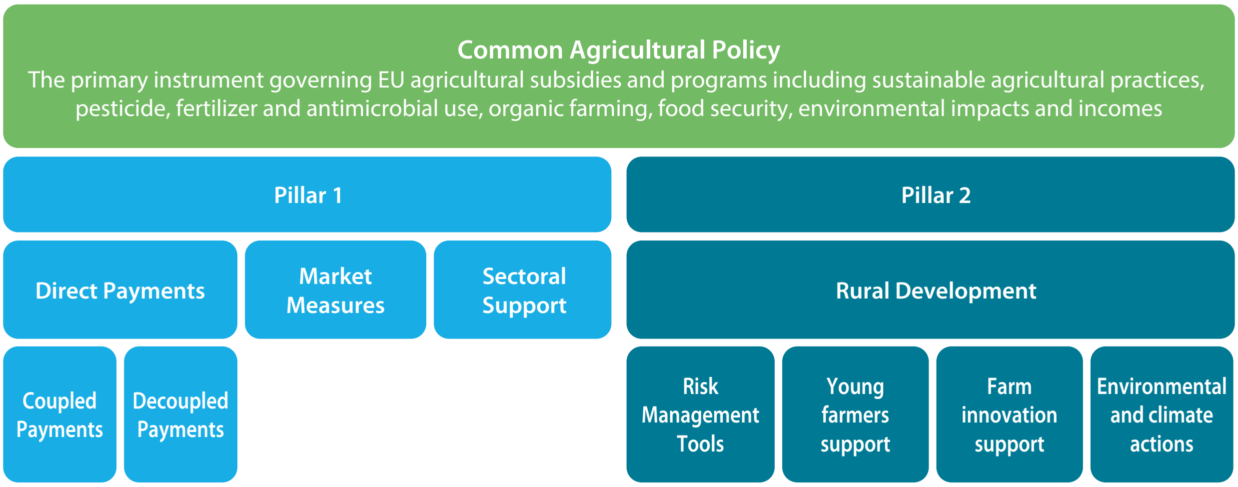
CAP reforms for 2014-2020 and 2023-2027 have formalised risk management tools as essential elements of the policy. These tools aim to stabilise farm incomes through market-based solutions such as insurance, income stabilisation tools and mutual funds.

CAP financing is structured around two pillars and multiple Sectoral Support Programmes, each with distinct funding mechanisms. Pillar I consists of direct payments to farmers and market measures along with Sectoral Support. It is financed exclusively by the EU through the European Agricultural Guarantee Fund (EAGF). Pillar II, which includes Rural Development Programmes, is co-financed by the EU and Member States. The EU contributes to Rural Development Programmes via the European Agricultural Fund for Rural Development (EAFRD), while Member States supplement this funding from their national and regional budgets.

Co-financing varies based on a region's economic level and the measure being implemented. For example, less developed regions can receive EU contributions of up to 85% of eligible costs, while more developed regions typically receive around 50%. Member States design their CAP Strategic Plans, outlining their priorities and co-financing arrangements which must align with EU regulations and be approved by the European Commission. Member States are reimbursed after verifying that expenditure complies with eligibility criteria, creating a system where responsibility for funding and implementation is shared between the EU and national governments.[15]

15 FAOLEX. (2024). Common Agricultural Policy – Legal Framework. Food and Agriculture Organization.

Figure 30: Structure of the EU Common Agricultural Policy.



Source: Authors, based on information sources from EC, DG AGRI.

Pillar I

The CAP First Pillar focuses on market support and direct payments to farmers. These measures help farmers cope with market fluctuations and weather-related risks, as well as contribute to sustainable income with:

a. Direct Payments

These provide farmers with a financial safety net, helping them maintain their business. This support is given in exchange for maintaining farmland and adhering to standards of food safety, environmental protection and animal welfare. Direct payments are provided in two forms:

- **Decoupled payments** are not linked to the production of specific crops or livestock. These are area-based payments providing farmers with a stable income, regardless of what or how much they produce.
- **Coupled payments** are linked to specific products, and farmers receive these only if they produce certain crops or livestock.

Direct payments benefit the EU by ensuring agricultural activities continue across the continent, adapting farming to local conditions, encouraging farmers to produce goods that consumers want and holding farmers accountable for meeting requirements related to public, animal and plant health, environmental protection and animal welfare. Farmers who fail to meet these requirements may receive reduced or no support.[16]

b. Market Measures

Market Measures aim to stabilise agricultural markets during times of disruption and crises. Instruments such as intervention buying and private storage aid may stabilise markets by purchasing surplus products or supporting private entities to store excess production until market conditions improve, particularly for cereals and dairy products.

16 European Council. (2024c). The Common Agricultural Policy explained. Available at: https://www.consilium.europa.eu/en/policies/the-common-agricultural-policy-explained/.

In times of severe crises, exceptional interventions such as subsidies for voluntarily reducing production and public repayments for loans help farmers cope with market shocks. For example, during the dairy sector crisis in 2015-2016, subsidies were offered to dairy farmers to reduce milk output, helping to rebalance supply and demand and support prices. Additionally, sector-specific rescue plans such as compensation for livestock losses due to disease, provide targeted relief during emergencies.

While these exceptional measures remain a part of the CAP toolkit, they are now seen as last-resort-measures, compared to the early days of the policy. In the past, CAP interventions were more frequent and extensive, with more financial resources devoted to direct market and production support. However, recent CAP reforms have shifted towards promoting market orientation and self-reliance for farmers, reducing dependency on direct government intervention. This reflects a shift towards a more liberal agricultural market, where farmers are expected to manage risks primarily through market-based instruments such as insurance and income stabilisation tools.[17]

c. Sectoral Support

CAP sectoral support addresses specific agricultural issues, allowing Member States to tailor interventions to individual markets. This support focuses on sectors such as viticulture, fruit and vegetables where investments should improve efficiency, enhance quality and address structural or market-specific challenges.

For example, investments in vineyard modernisation, market promotion to strengthen European wine's global presence or quality enhancement measures such as improved grape varieties. For fruit and vegetable producers, sectoral support may focus on infrastructure improvements such as better storage and packaging facilities, sustainable farming practices and capacity building through producer organisations. These targeted interventions are implemented through Member State CAP Strategic Plans, ensuring funding aligns with local priorities while supporting overarching CAP objectives such as sustainability, market stability and rural development.[18]

Pillar II

The Second Pillar focuses on rural development and is financed through the EAFRD. This fund is designed to balance territorial development in rural economies with a competitive, innovative and environmentally sustainable agricultural sector.

Unlike Pillar I, which provides direct financial support to farmers through mechanisms such as direct payments, Pillar II enables Member States to implement programmes tailored to their specific needs through nationally determined CAP Strategic Plans. These include improving agricultural and forestry competitiveness, enhancing the quality of life in rural areas, as well as financial support for crop diversification and environmental improvement, including landscape beautification.

CAP Strategic Plans detail how Member States allocate their EAFRD resources to rural development objectives. Member States can transfer funds between Pillars I and II, allowing them to adjust financial resources based on national priorities.

17 European Council. (2024c). The Common Agricultural Policy explained. https://www.consilium.europa.eu/en/policies/the-common-agricultural-policy-explained/.

18 EU CAP Network (2024). Sectoral Interventions and CAP Strategic Plans. https://eu-cap-network.ec.europa.eu/news/sectoral-interventions-and-cap-strategic-plans_en.

CAP Risk Management Tools (2023-2027)

CAP offers a diverse range of mechanism for farmers to manage their risks, including insurance, mutual funds for income stabilisation and prearranged public funds for disaster compensation.

Each measure addresses different aspects of risk and is financed through public and private resources under the guidance of Member State Strategic Plans:

Insurance Premiums Subsidies

Under Pillar II, these protect farmers against crop and livestock losses caused by adverse events. CAP provides subsidies to reduce the cost of insurance premiums, encouraging farmers to use insurance as proactive risk management.

Mutual funds and Income Stabilisation Tool

Also under Pillar II, these address income shocks faced by farmers due to production or market risks. They are often organised at cooperative or sectoral level but can also involve national structures. CAP allows Member States to support these tools with national contributions and EAFRD allocations, blending public and private resources.

Public funds for disaster compensation

In addition to these mechanisms, Member States can allocate public funds specifically for disaster compensation. These funds provide rapid financial relief for farmers following large-scale disasters and ensure a swift response to catastrophic events, helping to maintain agricultural production and rural livelihoods.

Part 2.2 Matrix of EU insurance agriculture systems

Methodology

To develop an appropriate classification for agricultural insurance systems, we compiled historical market data from a diverse range of sources. This facilitated a detailed analysis of insurance structures across EU countries, which we collated into the matrix below.

Data collection incorporated the following sources:

- Insurance Associations: These collaborate with government agencies, private insurers and international institutions to enhance agricultural risk management. They also collect, analyse and publish detailed data on national agricultural insurance markets.
- Insurance Companies: Major agriculture insurance providers release annual reports often containing insights into crop and livestock insurance policies, including premium structures, claims data and market trends.
- EU, Government, and Ministry Reports: Publications from the European Union, national governments and agricultural ministries provide valuable analyses of insurance markets, highlighting coverage gaps, accessibility challenges and areas for improvement in risk management.
- Scientific Literature: Research papers, theses and scholarly articles frequently examine agricultural insurance systems. Data was extracted from tables and supplementary material, while references were used to trace original data sources.
- News Articles and Press Releases: Where structured data was not readily available, journalism provided an overview of national agricultural insurance markets, offering insights into policy changes, industry developments and emerging trends.

The initial phase involved extensive data collection across all EU-27 countries, consolidating raw data and source links. A more in-depth analysis was conducted for the ten case study countries.

For these case studies, data was organised into five key analytical dimensions:

- Overall losses and damages by peril (breakdown of financial impacts based on different risk factors).
- Premium per crop and additional crop-specific data visualisations (insights into premium structures and associated data).
- Claims-to-premiums ratio (assessment of the financial balance between collected premiums and payouts).
- Crop insights by peril (detailed examination of how different risks affect specific crops).
- Subnational spatial joins and graphical representations (geospatial data visualisations for enhanced regional analysis).

To ensure clarity and comparability across countries, the data was translated into English and visualisations added. This enhanced accessibility, facilitated cross-country comparisons and provided deeper analytical insights into the structural differences and financial dynamics of agricultural insurance markets in the EU.

Classification of EU Agricultural Insurance Systems

EU countries have diverse agricultural insurance systems, each with distinct market characteristics. Some have well-developed private insurance markets that operate without support from CAP resources. Some Member States have very little crop insurance protection for farmers. Others rely on public insurance systems, where government schemes play a significant role. Most countries adopt a hybrid approach, fostering collaboration between the public and private sectors to create more adaptable and flexible risk management.

The following classification of agricultural insurance systems and markets in Europe provides a framework for evaluating their effectiveness and impact. By categorising and evaluating these systems, we can assess the protection available to farmers, determining whether current insurance schemes sufficiently mitigate financial risks associated with agricultural losses.

This classification enables us to analyse how well these systems address climate-related challenges, using our modelling analyses to measure their responsiveness to evolving risks. Furthermore, it facilitates an evaluation of public funding efficiency, ensuring that financial resources are used effectively to enhance agricultural resilience and sustainability.

The following **classification of agricultural insurance systems** has been applied:

a. Public Insurance Systems

Public agricultural insurance systems consist of state-administered insurance usually through a government-owned insurance company which may mandate compulsory participation in the insurance pool.

Public insurance systems often aim to increase coverage in the market and the government is likely to play a significant role in subsidising insurance premiums so that cover remains affordable for policyholders.

b. Private Insurance Systems

Private insurance companies freely set terms and administer cover in a competitive market. There is no significant pre-planned state-funded financial support and no premium subsidies. Private insurance contracts may benefit from tax relief, however this is not enough to classify systems as Public-Private.

c. Insurance Systems based on Public Private Partnerships

Insurance systems are PPPs when private insurance capacity is combined with prearranged government financial support. Although state involvement differs, all Member States with agriculture insurance PPPs provide government-funded premium subsidies.

Other interventions may include mandatory programmes to provide state-backed reinsurance for insurable risks, which enforces national pooling of extraordinary risks[19] or prearranged state participation in insurable risks. This could include state disaster funds with predefined payout criteria, acting as state capacity within the risk management system.[20]

There are two types of PPP insurance systems:

- **Countries using EU funding to subsidise premiums:** Member States can use Pillar II funds to subsidise up to 70% of agricultural insurance premiums.[21] France, Italy, Poland, Germany, the Netherlands and Romania have public-private agricultural insurance systems that use EU funds to co-finance premium subsidies.
- **Countries subsiding premiums with national funds only:** Spain and Austria have public-private agricultural insurance systems that do not use EU funds to co-finance premium subsidies.

As well as the insurance system classification above, the following market indicators were investigated:

a. Market Size

The size of an insurance market is measured by the Gross Written Premium (GWP). This is the sum of all insurance premiums written in a year and is a strong indicator of economic viability and market maturity.

Market size is important as insurers need to have a big enough pool of policyholders paying premiums to diversify risk within their markets and then obtain reinsurance capacity to further diversify their risks.

b. Insurance Uptake

The insurance uptake, known as insurance market penetration or coverage, can be measured in multiple ways.

- For agricultural insurance, it commonly refers to the percentage of farmed area or Utilised Agricultural Area (UAA) that has some insurance cover.
- In general insurance, it refers to the market size (GWP) relative to the overall value of the sector.

These metrics offer different views of market penetration. The percentage of UAA insured highlights the proportion of protected farmland, by at least some type of insurance, whereas the market size relative to economic size of the agricultural sector reflects the value of output that is protected. Both metrics are presented in the matrix.

19 Ibex Insure. (2024). Consorcio de Compensación de Seguros: Agricultural insurance framework.
20 Préfet de la Manche (2023) FNGRA – Fonds National de Gestion des Risques en Agriculture.
21 European Parliament. (2021a). Regulation (EU) 2021/2115: Common Agricultural Policy reforms. Official Journal of the European Union.

c. Past Market Profitability: Loss Ratio

The long-term loss ratio is typically a multiple year average ratio of insurance claims to insurance premiums collected (GWP). It indicates the extent to which insurers have been able to cover past claims with premium income. Insurers generally aim for an average loss ratio of 70-90%, which allows them to cover claims, administrative costs, reinsurance premiums, profits and reserves. For example, the target loss ratio for the US publicly supported crop insurance programme is 88%.[22] A long-term loss ratio near to or above 100% indicates that insurers have paid out more in claims than they earned in premium income, questioning the profitability and sustainability the business. Conversely, a consistently low loss-ratio would raise questions about the level of profits and reasonableness of insurance premiums.

This information is not consistently available for most EU agriculture insurance markets, and in the following pages we provide examples of relevant results and data where these have been found.

d. Number of Insurance Companies

The number of insurance companies can have a significant impact on the quality of a market, both in terms of product offering and farmers' access to these products. A market with multiple insurance providers promotes better prices and conditions, a wider variety of products as individual insurers can cover different perils and greater innovation (e.g. new loss assessment technology). These markets generally are also more transparent, as policyholders have better opportunities to compare prices and services, reducing information asymmetry between providers and customers.

e. Availability of Insurance Products

In EU markets the main types of agriculture crop insurance are:

- **Named Peril:** Protection against yield losses from a single, specified peril. Most often this is hail or storm damage.
- **Combined Insurance:** Protection against losses from several named perils. Most often this is hail or excess rain with some additions.
- **Multi-Peril Crop Insurance:** Protection against yield losses from an extensive rage of perils often including hail, storm, freezing, frost, drought, extreme rainfall and lightning.
- **Parametric Insurance:** protection against a predefined, index-linked hazard. For example, the volume of rainfall over a defined area used as a proxy for losses caused by extreme rain. At present this is offered in some markets, but often ineligible for premium subsidies because of regulatory or supervisory constraints in some jurisdictions.

There are various reasons why certain types of insurance may not be available in some markets, but generally the presence or lack of certain types of cover reflects the level of government support, with multi-peril crop insurance policies often too expensive without premium subsidies.

f. Participation: Compulsory or voluntary insurance is key to understanding insurance market trends.

22 Illinois Farm Policy News. (2023). Is loss ratio a sufficient measure of crop insurance performance?

Figure 31: Matrix of EU Member States and their key crop production insurance market characteristics and modes of funding.

	Market Characteristics					Insurance System Classification					Source of Funding	Subsidy	
	Total Insurance Premium	Insurance Penetration	Number of companies	Product Availability	Conditionality	Private	Public	Public Private Partnership: Premium Subsidy	Public Private Partnership: Government Participation in Cat Risk	Public Private Partnership: Public Reinsurance	Use of EU funds	Subsidy Amount (EUR)	Subsidy Amount (%)
Austria	234	H	1	N M P	V			x			N		< 55%
Belgium - Flanders	14	L	4	N M	V			x			N	83.94	< 65%
Belgium - Wallonia				N	V	x		Planned			N/A		0
Bulgaria	10	M	13	N	V			x			Y	22.2	< 70%
Croatia	30	M	5	N	V			x			Y		70%
Cyprus	8	VH	1	N	C		x				N	273.9	
Czechia	54	H	6	N	V			x			N		<65%
Denmark	0	VL	0		V	x					N/A	422.2	0
Estonia	0,5	VL	1	N	V			x			Y		< 70%
Finland	0,5	M	1	N	V	x					N	126.4	
France	856	M	9	N M R P	V			x	x		Y	172.7	< 70%
Germany	255	H	6	N M P	V	Federal		Some States			Some States	1.60	0
Greece	155	VH	3	N M	C		x				N		
Hungary	71	M	11	N M	C			x			Y	4128.1	< 65%
Ireland	0	VL	0		V	x						23.8	0
Italy	700	L	25	N M P	V			x	x	x	Y	5.72	<70%
Latvia	13	M	2	N	V			x			Y	147.1	50%
Lithuania	5	M	1	N	V			x			Y	99.6	< 70%
Luxembourg	7		1	N	V			x			N		<65%
Malta	0	VL	0	N	V	x					N/A	164.2	0
Netherlands	33	L	3	N M	V			x			Y	115.6	53%
Poland	130	M	7	N M	C			x			Y	180.3	< 65%
Portugal	33	L	5-7	N M	V			x		x	Y		< 70%
Romania	60	M	12	N M	V			x			Y	7.5	< 70%
Slovakia	14	M	4	N	V			x			Y	83.9	< 70%
Slovenia	5	L	4	N	V			x			N		< 60%
Spain	1011	M	16	N M P	V			x	x	x	N	2812.5	42%
Sweden	50	H	2	N	V	x					N/A	65.1	0
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)

(1) GWP, EUR millions, crop insurance only where available
(2) VH(>70%) H (>50%) M (20%-50%) L (<20%) VL (<1%)
(3) Most recent publicly available estimate of insurers with >1% market share
(4) Named (N) Multi Peril (M) Revenue (R) Parametric (P)
(5) Voluntary (V) Compulsory (C)
(6) Yes (Y) National Funds only (N) No Funding (N/A)
(12) Sum of EU, public and additional national financing for risk management tools under 2023-2029 CAP, EUR
(13) % Premium

Source: Authors.

Summary by country

This section summarises the agricultural systems of all 27 Member States with reference to the matrix. Further details on a sample group of 10 countries will be provided in Part 3.

Austria (PPP with no EU premium subsidy)

At the core of the Austrian agriculture insurance system is the Austrian Hail Insurance Company, which operates as a mutual. Farmers receive premium subsidies covering approximately 55% of costs.[23] This subsidy is funded through the national disaster fund, which is financed by income taxes. The fund supports agricultural premiums and allocates resources for disaster prevention and recovery efforts in other sectors.[24]

The Austrian model prioritises comprehensive risk coverage, addressing not only catastrophic events but also more frequent and local risks. This ensures that a wide range of crops, farming practices and livestock are protected, leading to a high participation rate, covering approximately 80% of Austria's UAA. In 2023, EUR 234 million in premiums were underwritten,[25] with a loss ratio of 83% for 2004-2023.[26]

Further details on the Austrian agriculture insurance system are provided in the case study in Part 3.2.

Belgium – Flanders (PPP with EU premium subsidy)

Since 2020, the Flemish government has offered subsidies for up to 65% of premiums, using CAP funds co-financed by the government, to support comprehensive weather insurance for crops (*Breede Weersverzekering*). With the introduction of this scheme, the government also limited the eligibility of farmers to seek compensation for losses resulting from adverse weather conditions from the Flemish Disaster Fund (*Vlaamse Rampenfonds*) to those with comprehensive weather insurance for at least 25% of their UAA.[27] (The Flemish Disaster Fund is due to be phased out completely by 2025).[28]

Flanders has a small agricultural insurance market, with approximately EUR 14 million in insurance premiums paid into comprehensive weather insurance schemes[29] and provided by four insurers (KBC, Agriver, Vereinigte Hagel, All Specialty Underwriting).[30] There is a low level of penetration, with less than 10% of the agricultural area insured. In 2020, the scheme's first year delivered a 130% loss ratio.

23 European Environment Agency (EEA). (2024). Subsidized drought insurance for farmers in Austria.
24 International Institute for Applied Systems Analysis (IIASA). (2024). Drought insurance factsheet: Austria.
25 Stakeholder Interview.
26 Bundesanstalt für Agrarwirtschaft und Bergbauernfragen. (2024). Agricultural Policy in Austria.
27 Vlaams Rampenfonds. (2024). Schade aan teelten en niet-binnengehaalde oogsten.
28 Vilt (2024). Wateroverlast van november erkend als ramp.
29 Vlaanderen.be (2021). Voorstelling BWV, Oktober 2021.
30 Vlaanderen.be (2025). Erkende breede weersverzekeringen huidige en voorgaande campagnes.

Belgium – Wallonia (Private)

Wallonia has a private agricultural insurance system with ad-hoc government support for extreme losses. Currently, there are no subsidies for agricultural insurance premiums. Several insurance providers cover excess rainfall, drought and hail.

The Walloon disaster fund compensates agricultural and animal production losses caused by exceptional natural events[31] (events with a 5% or less annual probability of occurring). Under the Walloon 2023-2027 CAP Strategic Plan, the adoption of premium subsidies for multi-peril crop insurance is under consideration.[32]

Bulgaria (PPP with EU premium subsidy)

Crop insurance premiums paid by micro, small and medium-sized enterprises are subsidised by up to 70% from the State Fund for Agriculture, supported by CAP Funds. The agriculture insurance market is small, with approximately EUR 10 million in premiums paid into named and combined peril insurance products[33] provided by 13 insurers.[34] The insurance penetration rate is 20% of UAA insured, with a loss ratio of 40% in 2022.[35]

There is also some ad-hoc government support for extreme losses. The Management Board of the State Fund for Agriculture has provided ex-post, ad-hoc support for farmers following agricultural disasters in the past including compensation for agricultural crop losses following frost, excess rain, hail and drought in 2023.[36] Conditions limit compensation to uninsured farmers to 50% of eligible support.[37]

Croatia (PPP with EU premium subsidy)

In Croatia premiums are subsidised up to 70%, co-financed by the central government and CAP funds.[38] The Croatian agriculture insurance market size is moderate with around EUR 30 million in premiums in 2023.[39] Five insurers provide coverage through named and combined peril policies.

Beyond insurance, Croatia has historically made use of both national and EU funds, through the EU crisis reserve, to compensate farmers with ex-post ad-hoc funding following agricultural disasters.[40]

Cyprus (Public)

Cyprus has a public agriculture insurance system. Previously administered through the compulsory, public Agricultural Insurance Organisation, risk management in primary agricultural production is now managed by the Department of Agriculture. The current system supports the incomes of farmers and livestock breeders in case of damage through the Special Fund for the Protection and Insurance of Agricultural Production.[41]

Agricultural Production Insurance is mandatory and universal, covering all farmers against multiple agricultural risks. The fund is financed partly by the state and partly by farmers in line with their risk profile.

31 Government of Wallonia. (2024). Requesting compensation for agricultural calamities in Wallonia.
32 Wallonia Ministry of Agriculture. (2024). Plan stratégique wallon.
33 ResearchGate. (2022). Determinants of insurance adoption among Bulgarian farmers.
34 Insurance Bureau of Bulgaria (FSC). (2022). Non-life insurance statistics 2022.
35 Ibid.
36 Министерство на земеделието (2023) 22,1 млн. лева са осигурени за компенсации на земеделските стопани за природни бедствия бедствия.
37 DFZ.bg. (2024) 6 млн. лева са осигурени за компенсиране на земеделски стопани за щети от природни бедствия през 2024 г.
38 Erevija. (2022). Characteristics of agricultural insurance in the Republic of Croatia.
39 HUO. (2023). Tržište osiguranja 2023.
40 Jutarnji List. (2023). Hrvatska traži pomoć EU za naknadu štete od suše poljoprivrednicima.
41 Audit.gov.cy (2019) ΟΡΓΑΝΙΣΜΟΣ ΓΕΩΡΓΙΚΗΣ ΑΣΦΑΛΙΣΗΣ ΕΙΔΙΚΗ ΕΚΘΕΣΗ ΓΙΑ ΤΗΝ ΠΕΡΙΟΔΟ 1.1.2019 ΜΕΧΡΙ 30.8.2019.

Czechia (PPP with EU premium subsidy)

Czechia has public-private agriculture insurance system with premiums subsidised by the Support and Guarantee Farming and Forestry Fund.[42] The PGRLF reimburses premium payments by 10% to 65% depending on farm size and product, using central government funding and CAP funds. The size of the agriculture insurance market is moderate, with around EUR 50 million[43] of insurance premiums paid into schemes provided by five insurers.[44] There is a relatively high level of insurance penetration, with some 50% of agricultural area insured,[45] with a long-term loss ratio of 86%.[46]

Ex-post, ad-hoc disaster funding is also funded in part by the state and the EU. This is provided to agricultural companies through the State Agricultural Intervention Fund (SZIF).[47]

Denmark (Private)

Denmark has a private agriculture insurance system with no governmment support. Previously only one insurance provider, Topdanmark, sold crop yield loss insurance on the Danish market. However, as a result of low uptake the company pulled out in 2023 leaving farmers unable to obtain coverage. There are currently no reported plans for Denmark to subsidise insurance premiums using CAP funds.

Estonia (PPP with EU premium subsidy)

Estonia has public-private agriculture insurance system where premiums are subsidised up to 70%. Subsidies are co-financed by the central government and CAP funds. Uptake is low, with premium payments below EUR 1 million[48] that cover less than 1% of the country's agricultural area;[49] the number of products offered on the market is limited.[50]

Finland (Private)

Until 2015 the Finnish Government operated the Crop Damage Compensation scheme (CDC), a farm and area based scheme covering crop yield losses in Finland, fully financed by Government.[51]

After the scheme was abolished in 2015 due to adverse selection and moral hazard. Some insurance companies attempted to develop their own market-based risk sharing instruments to fill the void. However, the market for such agriculture protection instruments did not grow as expected premium volume on the Finnish market is currently likely to be less than EUR 1 million.[52]

The Finnish Food Authority has made ad-hoc payments to farmers after some crises, including climate related agricultural disasters such as extreme rain in 2017. These were co-financed with EU funds.[53]

42 Agra pojišťovna. (2024). Agra pojišťovna hodnotí rok 2024.
43 Ibid.
44 Agrarministerkonferenz. (2019). Endgültiges Ergebnisprotokoll AMK Mainz 2019.
45 European Commission. (2023b). CAP Strategic Plan: Czechia.
46 Gabot.de. (2020). Vereinigte Hagel: Mitgliedervertreterversammlung.
47 NFPK. (2020). The Case: State Agricultural Intervention Fund.
48 Latvia University of Life Sciences and Technologies. (2022). Economic Science for Rural Development 2022.
49 Kliimaministeerium. (2024). Põllumajanduse ja kalanduse tulemusvaldkonna 2023.a. aruanne.
50 Estonian University of Life Sciences (2020), Factors affecting crop insurance decision of Estonian farmers.
51 Petri Liesivaara (2024) Catastrophic yield risks and the demand for crop insurance in Finland.
52 PIISA (2024). Majority of Finnish farmers recognise the impact of climate change, but lack tools to manage weather-based risks.
53 Ruokavirasto. (2024). Kriisituet.

France (PPP with EU premium subsidies)

France is the second largest user of CAP funds for premium subsidies under the risk management envelope. The country has a public-private agriculture insurance system with premium subsidies of up to 70% for multi-peril crop insurance products.

The French agriculture insurance market is one of the largest in Europe, underwriting around EUR 860 million in premiums annually.[54] Insurance penetration is moderate, with around 30% of the UAA protected by some type of insurance.

There have been major reforms to the French agriculture insurance system in recent years and further details are provided in the case study in Part 3.2.

Germany (Private at the federal level; PPP with EU premium subsidies in some Federal states)

Germany has private insurance with no federal government support, however some states (Länder) subsidise premiums for multi-peril insurance products using CAP Pillar II funds, co-financed with regional budgets. Subsidies vary by state, covering up to 50% of premiums for specified risks such as drought, frost and heavy rain. Insurance penetration is high, with 55% of the UAA covered by some type of insurance.[55]

The patchwork of subsidies across regions results in traditional named-peril products, such as hail seeing higher rates of uptake nationally, while non-traditional perils (such as drought) are mostly only accessible in regions offering subsidies. The mature and well-established operations of the private market also contribute to its scale. In 2023, approximately EUR 255 million premiums were underwritten through six insurance companies.[56] Underwriting performance can be consistent, with one provider reporting an average loss ratio of 72% for 2004-2023.[57]

In addition to agricultural insurance, Germany relies on state-level disaster relief to address catastrophic losses not covered by insurance. Each state has the autonomy to provide financial aid for agricultural disasters using its own budget. The federal government intervenes only in national-scale emergencies, providing ad hoc aid based on the severity of the event.

Further details on the German agriculture insurance system are provided in the case study in Part 3.2.

54 France Assureurs. (2023). L'assurance agricole en 2023.
55 Stakeholder interview.
56 Agrarministerkonferenz. (2019). Endgültiges Ergebnisprotokoll AMK Mainz 2019.
57 Gabot.de. (2020). Vereinigte Hagel: Mitgliedervertreterversammlung.

Greece (Public)

Greece has a public agriculture insurance system administered through the Hellenic Agricultural Insurance Organisation (ELGA), a non-profit public entity under the Ministry of Rural Development and Food. Premiums are calculated based on the insured value of crops or livestock.[58] ELGA is a self-financing mutual, investing surpluses in a reserve fund. It primarily covers hail, frost, and floods. Participation is mandatory and around 90% of the UAA is covered by some insurance. This high level of penetration means the market is relatively large, handling EUR 155 million in premiums in 2019.[59] Following an average loss ratio of 85% for 2011-2019, ELGA has experienced instability in recent years and loss ratios have been increasing, with premiums frequently falling short of claims, raising concerns for the future.

Private 'top-up' insurance is available for risks not covered by ELGA, such as fires on small plots or earthquakes, and is subsidised using CAP Pillar II funds. However, fewer than 2% of farmers purchase these supplementary policies.[60]

In addition to ELGA, the Greek government operates a disaster aid program that provides compensation for catastrophic losses that affect assets such as trees or vineyards rather than annual yields.

Further details on the Greek agriculture insurance system are provided in the case study in Part 3.2.

Hungary (PPP with EU premium subsidy)

Hungary has a public-private agriculture insurance system where premiums are subsidised by up to 70%, co-financed by the central government and CAP funds. The Hungarian agriculture insurance market size has 11 insurance companies receiving approximately EUR 70 million in premiums in 2023.[61] Approximately half of the UAA is insured to some degree.[62]

Hungary also operates a national Damage Mitigation Fund with compulsory participation for farms above a defined size, co-financed by annual farmer contributions and national funds. Agricultural enterprises can then claim compensation for the impacts of severe weather events. Farmers with adequate agricultural insurance, additional to the Damage Mitigation Fund, are eligible for a higher amount of compensation than the uninsured.[63]

Hungary also operates a National Hail Mitigation Network, funded by the Chambers of Agriculture, of over 1,000 silver iodide generators to prevent the formation of hail clouds. Hungary is also exploring a voluntary mutual fund which could be supported by CAP funds through income stabilisation tools.[64]

58 Greece Ministry of Agriculture. (2021). Agricultural Risk Management Strategic Framework.
59 Ibid.
60 Ibid.
61 Institute of Agricultural Economics (AKI) (2023). Mezogazdasagi Biztositasok.
62 fi-Compass (2023a). Presentation, Risk management measures in Hungary.
63 Kormány (2024), Referenciaárak, átlaghozam adatok és fajlagos költségmegtakarítási összegek a 2024. évi kárenyhítő juttatáshoz.
64 fi-Compass (2023a), Presentation, Risk management measures in Hungary.

Ireland (Private)

Traditionally, crop insurance has not been available in Ireland, and policies sold to farmers have been focussed on protecting building and equipment. However, over the last ten years, major crop losses have led to ad hoc emergency compensation payments to farmers, as well as growing calls for the introduction of a voluntary crop insurance scheme that aligns with the EU CAP support framework.[65]

For example, in 2023, Storm Babet caused extensive damage due to wind, excess rain and flooding[66] which led the Government to provide emergency post event compensation for farmers of approximately EUR 14 million, including over EUR 7 million from the EU Agriculture Reserve fund.[67]

Italy (PPP with EU premium subsidy)

Italy is the largest user of CAP funds through the Risk Management envelope, with over EUR 4 billion in funding planned for the 2023-2027 CAP. Premiums are subsidised by 50–70% using national and CAP funds. The insurance market is large, with EUR 700 million in premium underwritten by 25 insurers in 2023. Despite reforms to increase flexibility and accessibility, adoption remains low with around 10% of the UAA covered by some kind of insurance. The average loss ratio was 89% for 2013-2022.

The Agricat fund, introduced in 2022 and funded through a mandatory transfer of 3% of farmers' Pillar I direct payments, provides universal catastrophic risk cover for farmers. Italy also employs additional public funds such as the National Solidarity Fund to complement subsidised insurance. This fund addresses extraordinary risks and events not covered by standard insurance, providing ad hoc compensation.

Further details on the Italian agriculture insurance system are provided in the case study in Part 3.2.

Latvia (PPP with EU premium subsidy)

Latvia has a public-private agriculture insurance system where premiums are subsidised up to 50%, co-financed by the central government and CAP funds.[68] The Latvian market is relatively small, with EUR 13 million in premiums in 2021[69] which provided coverage for selected crops to approximately a third of the UAA.[70]

In the past, Latvia provided ex-post ad-hoc disaster relief payments to farmers where losses were not covered by subsidised crop insurance, including losses sustained from storms in August 2023.[71] There are calls for the development of a national mutual insurance fund with state support, to extend coverage to currently uninsured risks.[72]

65 O'Sullivan, K. (2023). Growers Seek Support from Government for Unharvested Crops.
66 Hickey, L. (2023). Call for tillage support following 'relentless' rain.
67 McDonnell. F. (2023) Additional €7.147 million funding package for tillage sector.
68 Lauku atbalsta dienests (2023). LA 17 Crop, Animal, Sow and Plantation Insurance Premium.
69 LV Portāls. (2022). Lauksaimniecības apdrošināšana.
70 Latvia Ministry of Agriculture. (2024). Agricultural insurance trends in Latvia.
71 LSM. (2024b). Latvia plans agriculture risk fund.
72 Latvia Ministry of Agriculture. (2024). Agricultural insurance trends in Latvia.

Lithuania (PPP with EU premium subsidy)

Lithuania has a public-private agriculture insurance system where premiums are subsidised up to 70%, co-financed by the central government and CAP funds. Named peril insurance is available for hail, frost, drought and excess rain. The market is small, with approximately EUR 5 million in premiums underwritten by one insurer. There is moderate uptake with approximately 23% of the agricultural area covered.[73, 74] Market performance has been strong, with a long-term loss ratio of 77%.[75] There is little evidence of past ad-hoc ex-post government support for Lithuanian farmers.

Luxembourg (PPP with EU premium subsidy)

Luxembourg has public-private agriculture insurance handling approximately EUR 7 million in premiums yearly,[76] with a long-term loss ratio of approximately 62% for 2008-2023.[77]

Premiums are subsidised by up to 65% for small to medium-sized farms, co-financed by the central government and CAP funds.[78]

Malta (Private)

Malta has a private agricultural insurance system with no government support through premium subsidies and no plans to subsidise premiums with CAP funds in the future. Agricultural production insurance is not widely available. Some state assistance has been provided through ad-hoc payments. For example, in 2019, under the State aid framework, EUR 1.5 million in compensation was distributed for agricultural losses from storms.[79]

The Netherlands (PPP with EU premium subsidy)

The Netherlands has a public-private agriculture insurance system with premiums for comprehensive weather insurance (Brede Weersverzekering, BWV) currently subsidised by approximately 53%.[80] This is co-financed using national and CAP funds. The market collected approximately EUR 60 million in premiums in 2023.[81] The market is led by two insurance companies which have consolidated their positions in recent years, providing named, combined and comprehensive crop insurance. Insurance penetration comprises 10-30% of agricultural area of main crop groups insured.[82] Market performance information is limited, but studies suggest the long-term average loss ratio is above 50% with improving performance in recent years.[83]

Farmers can also seek compensation for losses sustained from extreme events[84] under the Disaster Damage Compensation Act (Wet Tegemoetkoming Schade bij rampen, WTS) which is not specific to agriculture but covers various catastrophic events. The government has released funds six times, with four of these resulting in payouts to agricultural producers.

Further details on the Dutch agriculture insurance system are provided in the case study in Part 3.2.

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81 Ecorys (2024). Evaluatie van de Subsidieregeling Brede Weersverzekering.
82 Ibid.
83 Eerste Kamer. (2024). Evaluatie van de subsidieregeling.
84 Rijksoverheid. (2024). Wet tegemoetkoming schade bij rampen.

Poland (PPP with EU premium subsidy)

Poland's public-private agriculture insurance system co-finances premiums up to 65% by the government and CAP Pillar II funds. The government requires that certain types of crop and livestock production are insured for farmers to be eligible for wider support, creating a de facto mandatory insurance system for some risks. Farmers can also purchase voluntary insurance policies for additional risks.

In 2023, EUR 130 million in premiums were underwritten by five main insurers who offer a mixture of comprehensive and named-peril crop insurance policies, with almost 40% of the UAA covered by some type of insurance and an average loss ratio for 2001-2023 at of 68%.[85]

In addition to agricultural insurance, Poland operates a disaster relief programme to address catastrophic losses not covered by insurance. This programme compensates damage to infrastructure, productive assets and other long-term impacts on farming operations.

Portugal (PPP with EU premium subsidy)

Portugal has a public-private agriculture insurance system with 60%-70% of premium subsidised by the Ministry of Agriculture through the Institute for Financing Agriculture and Fisheries (IFAP). The subsidies use central government and CAP funds.[86] Approximately 6% of crops are insured,[87] with six insurers handling EUR 33 million in premiums in 2018.[88] Average loss ratios for 1996-2017 were 61% across three insurers.[89]

Portugal has a State funded mechanism through IFAP to finance extreme agricultural losses. This is a public reinsurance scheme, which can be used by insurers to supplement payouts when regular reinsurance is perceived as unaffordable.[90] This scheme was due to expire at the end of 2024, although it has been renewed annually since its inception in 2015.

Romania (PPP with EU premium subsidy)

Romania has a public-private agriculture insurance system, with premium subsidies of up to 70%, co-financed by national and CAP funds. Some insurance coverage is provided for approximately 30% of the UAA, mostly purchased by larger, consolidated agricultural producers.[91] Approximately EUR 60 million in premiums were collected in 2023.[92] Only named-peril insurance is available and the market is led by the Austrian Hail Insurance company, with share of around 50%.

Romania relies on national disaster relief funds to support farmers affected by extreme weather events. These funds are typically reactive, allocated on an ad hoc basis. For example, during severe droughts in 2020 and 2024, the Romanian government provided direct compensation to farmers. However, this support is often limited by budgetary constraints and does not provide the consistency or reliability of a dedicated disaster relief fund.

Further details on the Romanian agriculture insurance system are provided in the case study in Part 3.2.

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91 Agra Asigurări. (2024). Cum evoluează agricultura românească sub impactul fenomenelor meteorologice extreme.
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Slovakia (PPP with EU premium subsidy)

Slovakia has a public-private agriculture insurance system with premiums subsidised by the Ministry of Agriculture and Rural Development through the Agricultural Paying Agency. The agency reimburses premiums up to 70% under CAP rules, but subject to the annual budget allocation to the scheme, which is funded by central government and CAP funds. The market collected EUR 14 million in premiums in 2019[93], providing coverage for 35% of the UAA through four insurance companies.[94] Performance has been strong, with a long-term average loss ratio of 40% for 2014-2023.

Slovenia (PPP with EU premium subsidy)

Slovenia's public-private agriculture insurance system subsidises premiums by up to 60% for micro and medium-sized farms, using central government funding and CAP funds. The Slovenian market is small, with four insurers taking less than EUR 5 million in premiums in 2015[95], providing cover for 9% of the UAA.[96]

Under the Act on the Elimination of the Consequences of Natural Disasters, Slovenia provides ex-post funds to remedy damage to agricultural holdings as a result of extreme weather. Conditions limit eligibility, notably the inability to obtain agricultural production insurance to cover crop loss. The Act also enables the state to engage in other financing for agricultural risks, including the prepayment of disaster prevention funds, credit guarantees and repayment deferrals. [97]

Spain (PPP with no EU premium funding)

Established in 1978, Spain has one of the most sophisticated and comprehensive agricultural insurance systems in the world and is considered by many as the most advanced in Europe. It is a public-private agriculture insurance system, covering almost all crops and livestock risks in all regions, with premiums subsidised by the state using national funds. Policies are administered through Agroseguro, an entity that manages a consortium of approximately 16 private insurance companies that collectively underwrite standardised agricultural policies for crops, livestock, aquaculture and forestry.

The market is large, with over EUR 1 billion in premiums in 2023[98] , providing some level of cover for approximately 50% of the UAA. Insurance penetration varies significantly by region and crop type, with high coverage (over 80%) for arable crops and fruit trees, but just 14% for olive trees.[99]

Agroseguro purchases financial protection for catastrophic losses from the public reinsurer Consorcio de Compensación de Seguros.

Further details on the Spanish agriculture insurance system are provided in the case study in Part 3.2.

Sweden (Private)

Sweden has private agriculture insurance system with no government support. Uptake of insurance, where available, is above 60% usually covering only hail.[100] In 2023, Sweden's largest agricultural insurer, Länsförsäkring, serviced 80% of the market[101] handling approximately EUR 200 million in agricultural premiums for crops, forestry, livestock and greenhouses.

Sweden has granted farmers ad-hoc ex-post disaster payments in some extreme cases.

Further details on the Swedish agriculture insurance system are provided in the case study in Part 3.2.

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Part 3

Impact of climate change on national insurance systems and public prearranged disaster funds for agriculture

10 case-study countries

Part 3.1 Risk-layering

Features of insurance systems

All modern insurance systems (public, private, mutual and hybrid) are products of public policy and regulation. They are designed for selected objectives such as allocating risk between parties, applying shared rules and incentivising behaviour. Important features are:

- **Contingent Capital:** At their core, all insurance systems provide shared pools of capital available to beneficiaries in prearranged amounts, under agreed conditions, when defined events occur.
- **Governance:** Insurance contracts and risk pools define rules for members (clients) to join and access shared resources. These may include conditions to reduce financial risks to the pool (and society), such as climate adaptation interventions, or defined uses and protocols for payouts ('build back better').
- **Solvency:** Risk pools (including insurance companies) manage contingent liabilities (potential payouts) with funds available in the pool, known as capital reserves. In general, risk pool annual inflows (premium) should meet annual average expected payouts plus cost and profit margins.
- **Solidarity:** Annual costs of membership are driven by the risk-based cost of a members' protection, which provides incentives for risk reduction. In some circumstances subsidies are provided to support affordability and solidarity.
- **Pool Purpose:** Most insurance is arranged because governments seek to limit their own liabilities, or the liabilities of citizens to each other (e.g. third-party motor insurance,) or because creditors require it such as home and life insurance for mortgage holders.
- **Risk Layering:** Generally, the primary risk owners hold the low layer, smaller more frequent (attritional) risks and transfer higher layer risks. For agricultural insurance it typically starts with the farmer, then the insurer, reinsurer, and finally governmental or possibly multi-national coverage.

- **Diversification:** Generally larger and more diverse pools diversify risks and underwrite these more efficiently (cheaply) so they can manage greater levels of risk and shocks. Major reinsurance companies manage extensive and diverse portfolios that enable them to underwrite large risks beyond the capacity of smaller insurance companies.
- **Economic Rationale:** Members, including governments, join risk pools to reduce exposure to extreme financial volatility that could put their operations, budgets, or creditworthiness under stress. They also join risk pools to normalise the management and financing of disasters while providing predictable protection and services to citizens. Ultimately, pool members will arrange protection that matches their needs, circumstances and existing protection.
- **Financial Instruments:** Despite a myriad of products there are fundamentally two types of insurance i) indemnity (traditional) that pays out when a defined asset is affected by a defined peril and ii) parametric (non-traditional) with protection from a defined loss event with specified attributes and location (e.g. severe drought).
- **Risk Capital:** Under appropriate arrangements, risk capital can be provided by the public sector, the insurance sector or mainstream capital markets via instruments such as catastrophe bonds. Often these instruments are blended. This capital, with pre-defined contractual obligations, represents a contingent asset matched against a contingent liability.

Risk-layering and role of the public sector

To evaluate the effectiveness of insurance systems within weather-related agricultural risk management we use 'risk layering'.

This applies the risk quantification techniques used in this report (see Part 1) where events fall into three classifications:

- Low severity: These occur frequently causing attritional losses and are usually managed through a farmer's own funds.
- Medium severity: These occur less often but cause serious damage affecting the solvency or creditworthiness of a farming business. Insurance is often used to manage these risks.
- High severity: These occur rarely but have devastating impacts, such as major natural disasters or large-scale economic crises. These risks are typically addressed through risk transfer mechanisms such as reinsurance or government disaster relief, as they are too costly to be absorbed by farmers or insurance providers.

Risk is the exposure and vulnerability to those events, which risk layering frameworks manage according to three principles: risk retention, risk transfer and residual risk.

Risk retention

This typically refers to small, relatively frequent losses that farmers absorb within their own budgets. Farmers either implicitly allocate resources or explicitly set aside funds to cover such losses from recurring events. While risk retention enhances resilience, it also necessitates strategic financial planning to ensure sufficient reserves to mitigate potential financial impacts.

At this layer, farmers bear the risk of frequent events that lead to incremental, or attritional losses, since covering such losses through private or public sector insurance mechanisms would be economically unsustainable. However, the public sector plays a role in enhancing knowledge of climate adaptation strategies and climate projections. By improving farmers' awareness of how climate change may impact their operations and revenue streams, public initiatives can empower them to make informed decisions and strengthen long-term sustainability.

Risk transfer

Risk transfer refers to the process of shifting the financial burden of a defined loss event from one party to another. This typically involves insurance-based solutions but can also include public support mechanisms, such as ad-hoc government payments following extreme losses, or dedicated agricultural funds.

Most risk transfer mechanisms, such as insurance, incorporate an element of risk retention through deductibles and payments are only triggered when losses exceed a predefined threshold. If expected losses are below or only slightly above this threshold, the cost of insurance may outweigh the benefits.

The public sector plays an important role in facilitating risk transfer in several ways. One approach is through premium subsidies which help reduce the financial burden on farmers, making insurance more accessible. Additionally, governments can establish catastrophe funds or mutual insurance schemes to provide financial support for farmers facing severe losses. These initiatives can be complemented by training programs and knowledge-sharing sessions to enhance farmers' understanding of risk management strategies.

Given specific challenges in the agricultural sector, the public sector is instrumental in promoting standard yield metrics across countries. This standardisation is essential to enabling EU-wide risk modelling, improving the accuracy of insurance products and ensuring a more efficient and equitable distribution of financial protection.

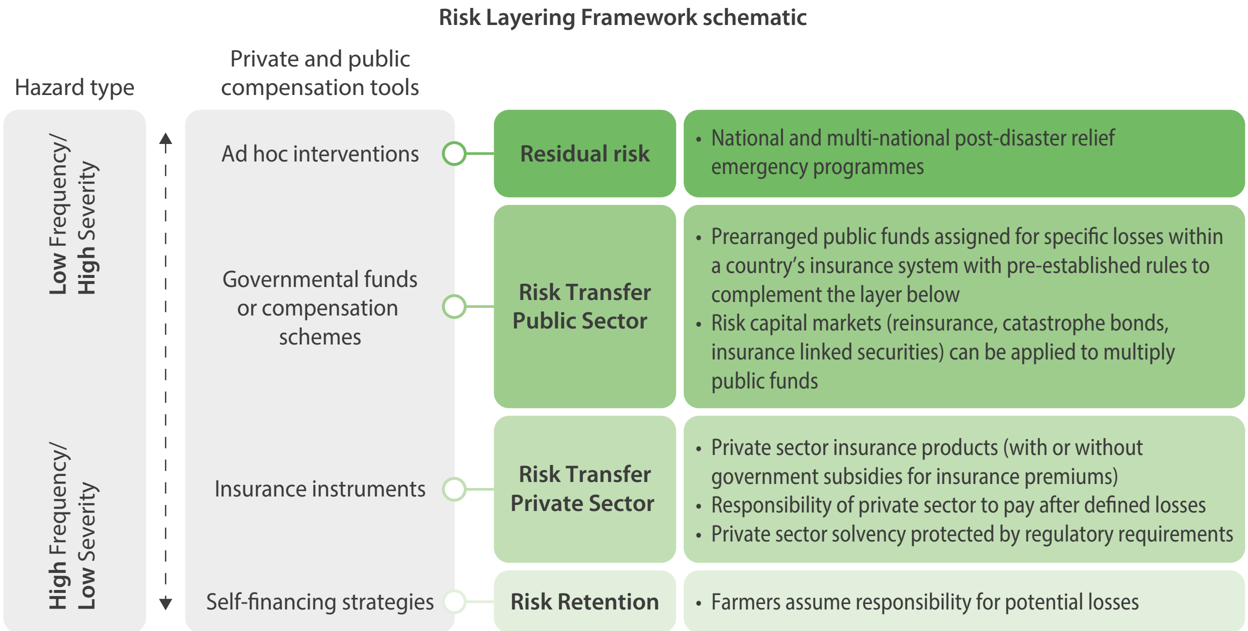
Residual risk

Residual risk refers to the financial exposure resulting from extreme events and catastrophic losses that exceed the coverage limits of private and public sector risk management instruments. These events are typically rare but have severe consequences, leaving affected farmers without sufficient financial protection.

In such cases, the public sector is the payer of last resort, providing post-disaster relief to support recovery. This assistance is often delivered through ad-hoc financial aid from national governments or EU funds, helping to stabilise the agricultural sector in the aftermath of extreme losses.

Parts 2 and 3 illustrate how these elements relate to each other in agricultural insurance systems.

Figure 32: Risk layering framework schematic.



Source: Authors.

Risk reduction and adaptation across the layers is essential to manage risks and increase resilience to:

- reduce risk retention and residual risk, and
- encourage and maintain affordable insurance.

Figure 33: The risk management virtuous circle.

Part 3.2 Analysis overview

Approach and Methodology

This section provides high level estimates of the distribution of possible losses across different participants in the agricultural risk management system (farmers, insurers and government) for the four perils (drought, frost, hail and rain). We present estimates for current climate conditions, as well as a future 'stress test' using the SSP5-8.5 scenario, which is a reasonable upper boundary based on current scientific consensus.

This section explores the impact of climate risks on insurance and post-event compensation systems in ten Member States that provide a representative sample of EU climates, agricultural production and insurance systems: Austria, France, Germany, Greece, Italy, the Netherlands, Spain, Sweden, Poland and Romania. The following criteria was applied:

- **Size:** The sample includes the largest and smaller agricultural economies.
- **Geography and Crops:** A wide range of agroclimatic zones with various perils, crops and risk trends.
- **Insurance systems:** A range of insurance system classifications and levels of government intervention.
- **Use of EU funds:** Varied use of CAP funds for insurance related protection.

The following analysis of each country's insurance system includes:

- A summary with key market data, features and dynamics, as well as an assessment of the ability of the system to address perils, crops and layers of risk, the role of private, national and EU institutions and evidence of past insurance performance.
- A construction of simple models of national insurance systems to estimate how the impacts of different types of loss events (attritional, major, catastrophic) on crops are allocated across the system.
- An application of the results of the agricultural climate risk modelling, described in Part 1 and detailed in Annex II, to a financial model of the national insurance system to estimate the distribution of losses for farmers, insurers and governments and the size of the protection gap.

Insurance penetration

Low insurance penetration rates preclude many farms from receiving insurance payouts, leaving a high proportion of losses for farmers. In many countries precise rates for crop insurance are not available and we have made best-efforts estimates based on various sources.

Events, Losses and Risk Allocation

Climate events have varied impacts on different crops with some having low yield losses and others higher depending on their vulnerabilities. These impact assessments are significant because most insurance and prearranged public systems compensate farmers when yield losses exceed a predefined threshold (deductible), which typically sits at around 20% but this can vary. The analysis allows us to express projected losses from events by the reductions in yield that are expected to cause them.

Prearranged public financing and ad-hoc payments

Any prearranged public risk financing is often triggered by yield losses over defined thresholds, as accounted for in the methodology. This analysis does not account for ad-hoc State aid payments as these are not prearranged risk financing and have no predictable or structural role in agricultural risk layering and protection. Uncertain and unplanned ad hoc support is challenging for farmers, insurance markets and Member States. Its existence and expectation can introduce inefficiencies, moral hazard and disincentivise insurance uptake.

We estimated the proportion of expected current and future losses from each primary peril borne by i) farmers through uninsured losses or deductibles in their insurance policies, ii) insurers through payouts and iii) Member States through prearranged risk finance.

Structure per country

We applied the risk modelling results (primary perils and yield loss) through an additional financial model, which we built exclusively for each sample country, piecing together its different layers of protection, thresholds, crops and current insurance coverage for each layer.

The results show the net loss to farmers and the allocation of payouts from relevant parts of the insurance system (i.e. private sector or government).

The analysis in each of the countries is structured under:

- Key reference information;
- Insurance system summary;
- Structure of the insurance system and observations to date;
- Risk-based assessment for current conditions and 2050;
- Other public funds for disaster finance that are not part of the insurance system;
- Examples of severe loss years;
- Observations.

Part 3.3 Public insurance systems
Case study: Greece

Key reference information

Agriculture as % of GDP	4.1 %
Agriculture % of national employment	11.8%
Agriculture as % of exports	21.4%[102]
Major crops (share of agricultural output)	28% Fruit 16% Vegetables and horticultural products 9% Industrial crops 7% Olive oil 6% Forage plants[103]
Primary climate perils	Drought, Wildfires Flooding, Frost

Insurance system summary

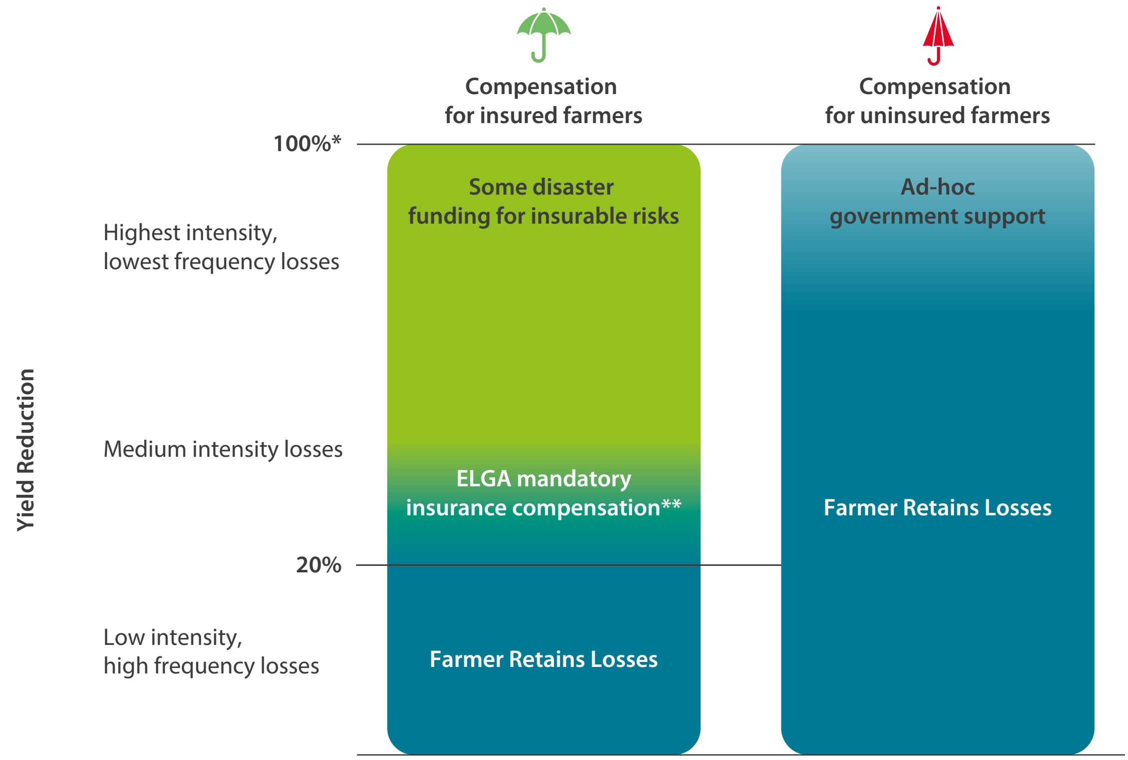
Perils insured	Hail, Drought, Floods, Frost, Fire
Crops insured	Arable crops, Fruit and Vegetables, Industrial crops, Vineyards, Specialty crops (pistachios, tobacco, etc.)
Compulsory insurance (by crop or peril)	Yes, Public compulsory insurance coverage
Overall Insurance penetration	Quasi-universal ~90%
Average loss ratio	80-90%
Number of insurance companies	Three
% of premium subsidised	Approximately 70% premiums subsidised
Public sector risk pool in the insurance system	No

102 European Commission (2021e). Statistical Factsheet Greece.
103 Ibid.

Structure of the insurance system and observations to date

Insurance system structure

Figure 34: Schematic of Agricultural Insurance Layering in Greece.



Source: Authors.

* Maximum sums insured are determined by negotiations between farmers and insurers but within limits set by the government.

** ELGA funds not guaranteed to cover all losses within insured layer.

The agriculture insurance system in Greece is managed by the Hellenic Agricultural Insurance Organisation (ELGA) as a public and mandatory scheme under the Ministry of Rural Development and Food. Its primary purpose is to provide insurance for crop and livestock producers against weather-related yield losses. Farmers are required to contribute premiums, which fund claims and administrative expenses. However, the system faces significant structural, financial and operational challenges.[104]

ELGA insures medium-risk crops such as grain, cotton, grapes and vegetables, but high-risk crops like peaches, nectarines and cherries are often excluded due to elevated claims risks. The system generates EUR 165–175 million annually in premiums, however claims and administrative costs have consistently exceeded EUR 200 million in recent years, creating substantial financial deficits.

Greece uses the Rural Development Programme funds to subsidise premiums. Between 2023 and 2027, EUR 4.1 billion was allocated from EAFRD to enhance the affordability and accessibility of agricultural insurance.[105]

104 Greece Ministry of Agriculture. (2021). Agricultural Risk Management Strategic Framework.pdf.
105 Ibid.

Other public funds in Greece for disaster finance that are not part of the insurance system

In addition to ELGA, the Greek government operates a disaster aid program that provides free compensation for catastrophic losses that **affect productive assets such as trees or vineyards, rather than annual yields**. The disaster aid program complements ELGA by ensuring farmers have recourse to both yield and asset protection but avoiding double compensation for the same risk.[106] For risks such as wildfire, disaster aid applies only if the damage is extensive (over 50 hectares); smaller wildfire losses are not covered under any scheme.

Examples of severe loss years

a. 2021

In 2021, severe frosts in March and April severely impacted fruit trees and vines in several regions. Further losses were reported from heavy hailstorms in June, primarily affecting tree crops, vines and vegetables in Pella and Karditsa, and a heatwave in July and August caused additional damage, especially to vineyards in Corinth, Heraklion and Achaia. Reported damages were EUR 354.17 million, with compensation of EUR 345.59 million provided by ELGA. However, the increasing frequency of such events has strained ELGA and highlighted challenges for farmers to manage persistent climate risks. Events like these are now expected to occur with a 5-10% probability each year with their compounding effects adding stress to agricultural production and financial resilience.[107]

b. 2022

In 2022, adverse weather conditions continued to impact Greek agriculture, with frosts in January damaging citrus crops in Argolis and frosts in March and April affecting fruit trees in Pella and Imathia. Heavy hailstorms in May, June and July caused widespread damage to tree crops, vines and horticulture in regions such as Pella, Kavala, and Imathia. August rainfall further affected vineyards in Heraklion and Corinth. Reported damage totalled EUR 264.38 million, with ELGA compensating EUR 241.70 million. Although the compensation provided substantial support, many farmers faced significant delays and administrative hurdles in accessing relief.[108]

c. 2023

2023 brought further challenges for Greece's agricultural sector, with extreme weather causing significant and unprecedented damage, particularly in the Region of Thessaly. Frosts in March and April severely affected fruit crops, while heavy hailstorms from April to June damaged tree crops, vines and vegetables in Pella and Imathia. Rainfall in May and June impacted legumes, cotton and cherry crops, while July heatwaves caused widespread damage to vineyards in the Corinthian region. The most catastrophic events, however, occurred in September with storms Daniel and Elias, which brought record-breaking rainfall and extensive flooding to Thessaly. These storms, with an estimated 0.5% probability of occurring in any year, devastated crops and agricultural infrastructure, leaving the region's primary sector in a state of crisis. In Thessaly almost 70% of the cotton crop was damaged with production reduced by at least 50–60%, impacting Greece's total cotton production by 15–20%.

Reported damages for the year amounted to EUR 461 million, with ELGA providing compensation of EUR 452.5 million, a high coverage rate. Additionally, the European Commission allocated EUR 43.1 million from the Agricultural Reserve 2023 to Greece, offering further support for the recovery of farmers and businesses affected by these climatic and macroeconomic challenges.

106 Ibid.
107 ELGA Agriculture Report 2021.
108 ELGA Agriculture Report 2022.

Despite these measures, the intensity and scale of losses exposed the significant strain on ELGA's administrative and financial capacities. Farmers faced delays in compensation processing and the unprecedented flooding highlighted the need for enhanced resilience mechanisms. The events of 2023, following the two previous years' losses, illustrate the increasing challenge for Greek farmers and risk management systems to adapt to the growing severity and frequency of extreme weather. Improvements to the financial resilience of agricultural insurance and disaster response mechanisms are expected.[109]

Risk-based Assessment: current conditions and 2050

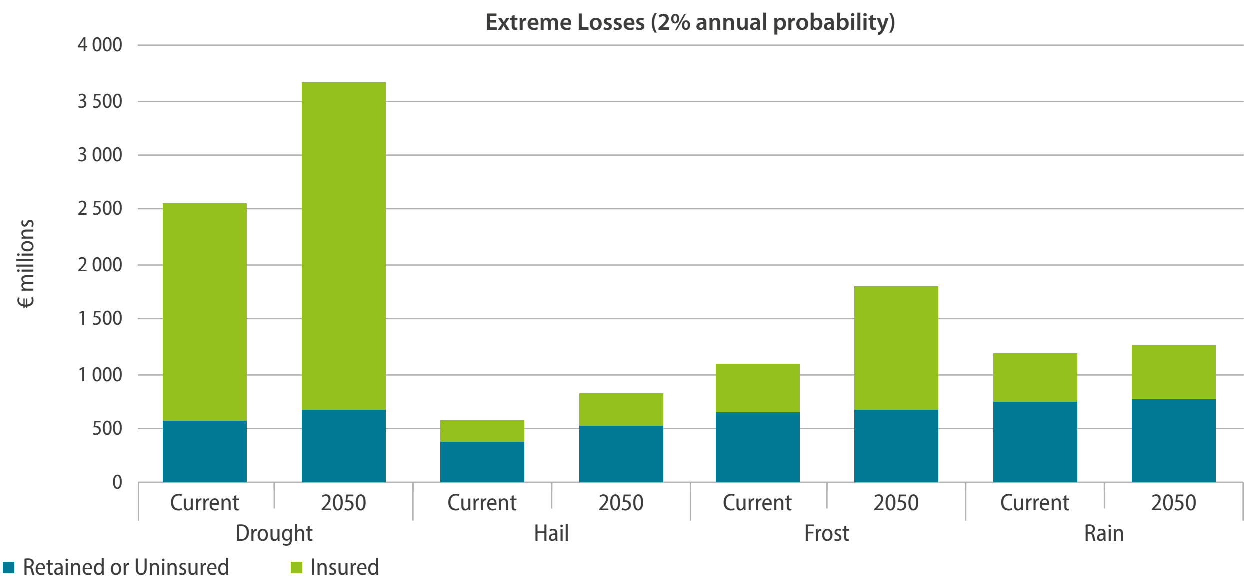
a. Protection gap and primary perils for extreme losses

Aggregate extreme losses from drought, hail, rain and frost with a 1-in-50-year, or 2% annual probability are currently around EUR 3 billion.

The drought PML in extreme loss years (1-in-50) is currently approximately EUR 2.56 billion but estimated to increase by 43% to EUR 3.65 billion by 2050. By 2050, a greater proportion of losses will be driven by crop yield losses exceeding 30%. Under the current insurance market design, this would lead to an increase in retained or uninsured losses but a greater proportion of losses would fall on ELGA.

The current frost 1-in-50 PML is approximately EUR 1.08 billion but expected to increase by 66% to EUR 1.79 billion by 2050. Our analysis shows that, under the current system, an increase in the severity of yield losses would trigger more insurance payouts, which would mostly fall on the national insurance system.

Figure 35: Risk layering for extreme (1-in-50 year) losses (2% annual probability) - Greece.



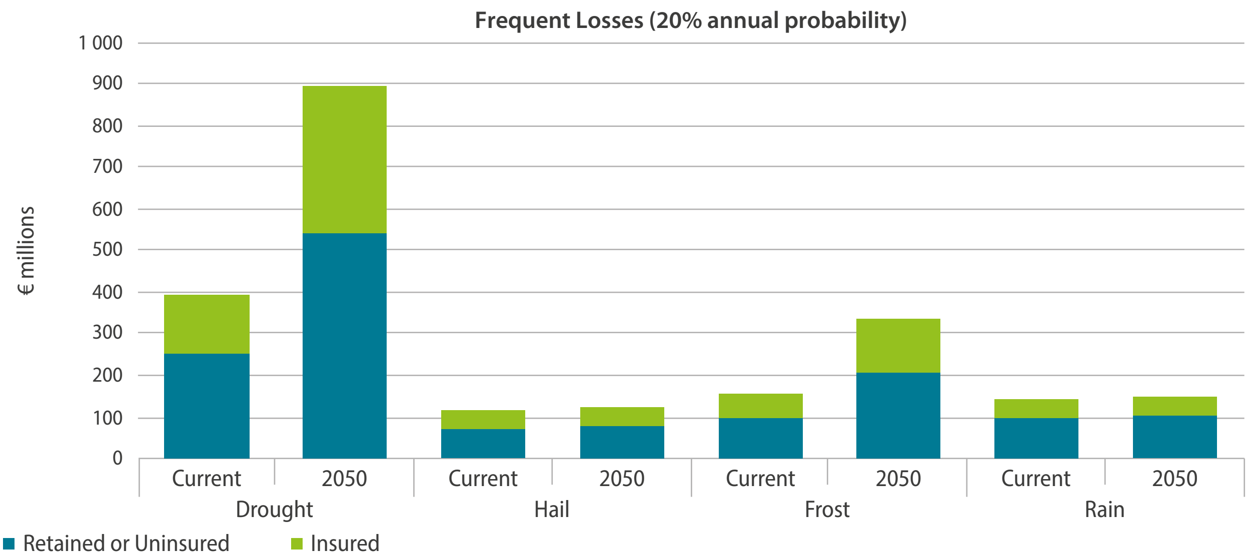
Source: Authors.

109 Elga Agriculture Report 2023.

b. Protection gap and primary peril for frequent losses

Currently, over 60% of losses from frequent (1-in-5) loss years from the primary perils are expected to be uninsured or retained by farmers. The severity of losses caused by different perils varies, so the insurance payments differ and the proportion of losses that are expected to be retained or uninsured varies for each peril. Drought is the primary peril for crop losses in Greece, but insurance covers a broad range of crops, as well as being mandatory, so a lower proportion of frequent drought losses fall to farmers than in other countries. By 2050, frequent (1-in-5-year) losses from drought are expected to more than double, with increasing losses being covered by insurance and farmers in near equal measure.

Figure 36: Risk layering for frequent (1-in-5 year) losses (20% annual probability) - Greece.



Source: Authors.

Part 3.4 Private insurance systems
Case study: Sweden

Key reference information

Agriculture as % of GDP	1.2%[110]
Agriculture % of national employment	1.9%[111]
Agriculture as % of exports	4.4%[112]
Major crops (share of overall agricultural output)	20% Forage plants 14% Cereals 10% Vegetables 4% Potatoes 4% Industrial Crops[113]
Primary climate perils	Drought, Frost

Insurance System Summary

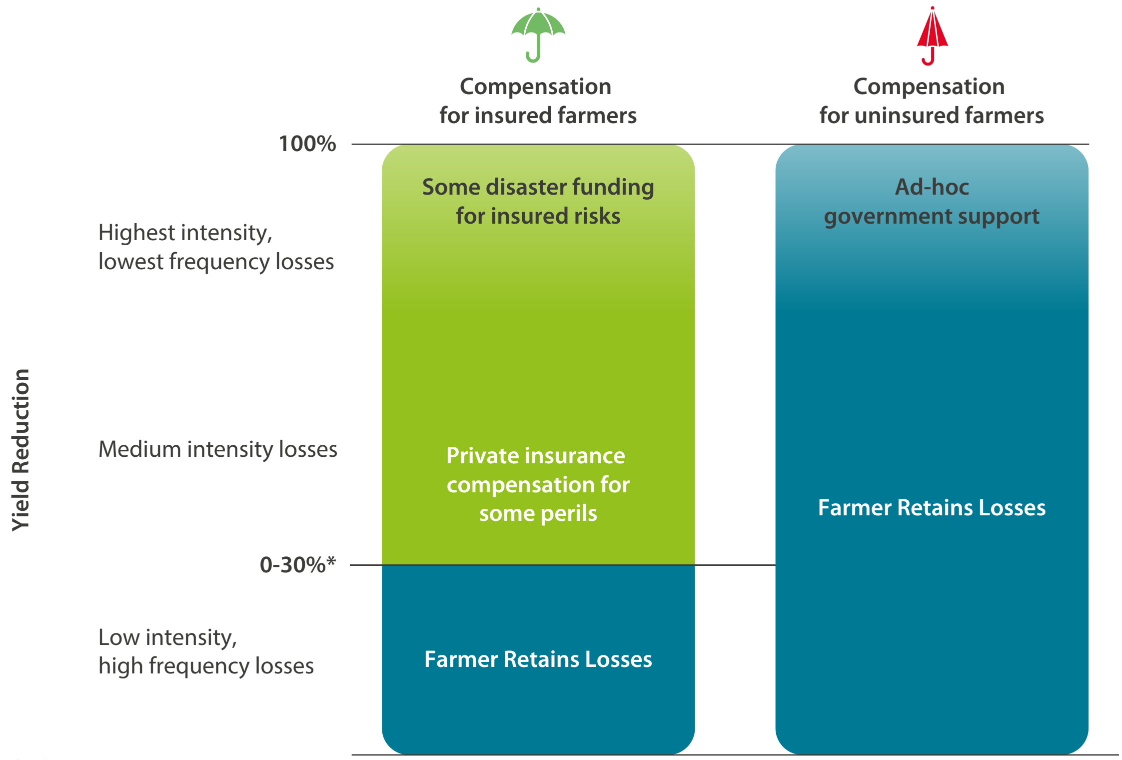
Perils insured	Hail, Fire, lightning, storm, snow pressure, drought, frost, pest[114, 115]
Crops insured	Cereals, legumes, oilseeds, potatoes, sugar beets, Vegetables, Livestock, Forest
Compulsory insurance (by crop or peril)	No
Overall Insurance penetration	60%
Average loss ratio	Unknown
Number of insurance companies	Two
% of premium subsidised	0%
Public sector risk pool within the insurance system	No

110 World Bank. (2023a), Agriculture, forestry, and fishing, value added (% of GDP).
111 World Bank (2023), Employment in agriculture (% of total employment).
112 European Commission. (2023h), Statistical Factsheet Sweden.
113 Ibid.
114 Dina Försäkringar. (2024), Lantbruk och hästgård Villkor 2024.
115 Agria. (n.d.), Lantbruksförsäkring: Gröda försäkring.

Structure of the insurance system and observations to date

Insurance system structure

Figure 37: Schematic of Agricultural Insurance Layering in Sweden.



Source: Authors.

* Policy terms set freely by insurers. Deductibles between 0-30% of losses depending on peril and product type.

The Swedish agricultural insurance market is one of the oldest in Europe, with livestock insurance introduced as early as 1890. The market has historically been supported heavily by the State and insurance was compulsory for some time. Today, however, there is no public support through premium subsidies or guarantees and the agricultural insurance market operates on a purely private basis. Despite a lack of subsidy, there is a relatively high uptake (above 60%) of insurance where it is available, usually covering hail.

Other public funds in Sweden for disaster finance that are not part of the insurance system structure

The costs of adverse weather has largely fallen to farmers, but in some extreme cases the government has granted farmers ad-hoc, ex-post support, such as the 2018 and 2023 examples summarised below.

From 1 January 2023, following the provision of CAP funds towards an agricultural reserve, Member States could apply to draw from EUR 450 million fund during extreme agricultural crises.[116] Such funds were used by Sweden in 2023, after a summer of drought, frost and extreme heat, followed by heavy rains later in the year (see below).[117]

Examples of severe loss years

a. 2018 drought

During the severe drought of 2018, the Swedish Board of Agriculture introduced a support initiative of SEK 1.2 billion (EUR 117 million) which was extended by SEK 460 million in payments and tax cuts for animal owners.[118] Over the course of 2018 and 2019, approximately EUR 130 million was disbursed to farmers as financial relief. The burden of these measures laid wholly with the Swedish state as EU funding measures had not been implemented.

b. 2023 drought, frost, excess precipitation

Damage and disruption caused by frost, drought, rain and extensive flooding resulted in waterlogged farmland and floods, reducing fodder to feed livestock and limiting autumn crop sowing.

The Swedish government provided SEK 127 million (EUR 11 million) from the national budget to support farmers.[119] An additional SEK 66 million (EUR 5.75 million) was supplemented by the EU through the newly formed crisis reserve fund. Drought insurance is not widely available, and losses from this event were mainly borne by farmers and the state.

116 European Commission. (2024b), EU exceptional market measures enhance agricultural sector resilience amidst crises.
117 Jordbruksverket (2023). Krisstöd till jordbruksföretag 2023.
118 Swedish Government. (2018),Proposition 2017/18:301.
119 Swedish Government. (2023, December), Krisstöd till Sveriges lantbrukare efter sommarens vädersituation börjar betalas ut .

Risk-based Assessment: current conditions and 2050

a. Protection gap and primary peril for extreme losses

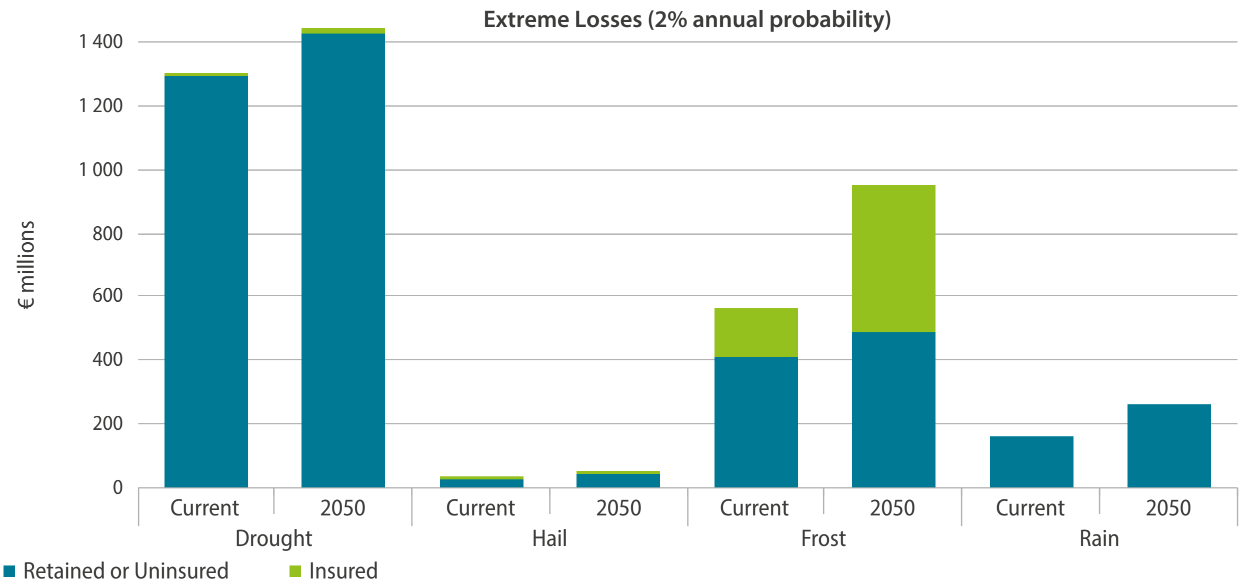
1-in-50-year PMLs from drought, hail, rain and frost are currently over EUR 1.5 billion in Sweden. Higher insurance penetration rates for hail and frost have resulted in a lower protection gap for these perils. Protection gaps for drought and excess rain are approximately 100%.

By 2050, a greater proportion of expected losses from hail and frost should be covered by existing insurance systems. However, in a private and unsubsidised market this indicates an increasing pressure on insurers to tighten conditions with policy restrictions, higher deductibles, less favourable terms or higher premiums.

The current frost 1-in-50 PML is approximately EUR 600 million which is expected to increase to almost EUR 1 billion by 2050. Under current insurance policy conditions, most of the increased losses would fall on insurers but, as with hail, insurers will have to tighten conditions which will increase costs for farmers.

The current drought 1-in-50 PML is approximately EUR 1.3 billion, expected to increase by 8% to EUR 1.4 billion by 2050. Under current insurance market conditions, almost all these losses would be borne by farmers.

Figure 38: Risk layering for extreme (1-in-50 year) losses (2% annual probability) - Sweden.



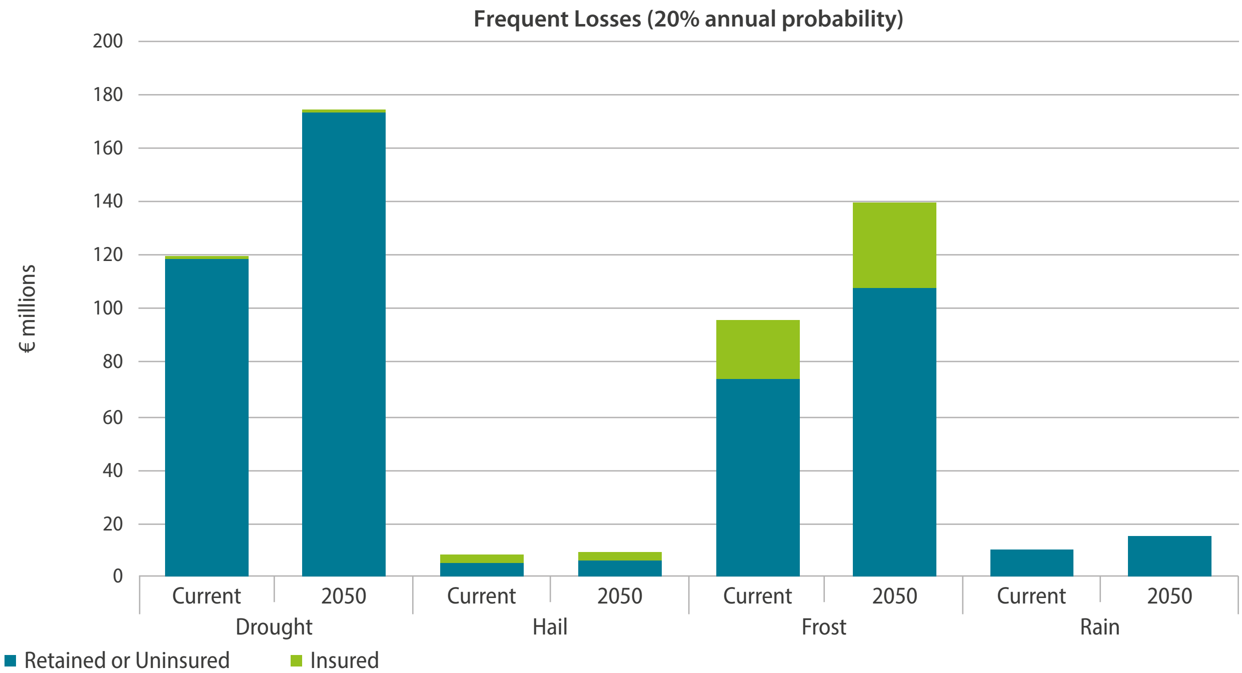
Source: Authors.

b. Protection gap and primary peril for frequent losses

Between 70% and 100% of frequent (1-in-5-year) losses from the primary perils are expected to be entirely uninsured or retained by farmers. Drought has become the primary peril, but very limited insurance coverage means that almost 100% of frequent drought losses fall on farmers. By 2050, frequent losses from drought are expected to increase by approximately 46%, falling almost entirely on farmers. However, ad-hoc public compensation following droughts could place more pressure on state funds.

1-in-5-year PMLs from frost are expected to increase by approximately 45%, with much of the increase borne by farmers who are expected to retain a larger proportion within current policy terms. These frequent losses could undermine their ability to recover from bad years and may impact long term financial stability, including access to credit and the ability to invest in their businesses.

Figure 39: Risk layering for frequent (1-in-5 year) losses (20 % annual probability) - Sweden.



Source: Authors.

Part 3.5 Public private partnership agriculture insurance systems: *Public premium subsidy without EU financing* Case studies: Austria and Spain

Austria

Key reference information

Agriculture as % of GDP	2%
Agriculture % of national employment	4% of national workforce
Agriculture as % of exports	9.1% of total export[120]
Major crops (share of overall agricultural output)	12% Cereals 11% Vegetables and horticultural products 8% Forage plants 8% Wine 4% Fruit 4% Industrial crops[121]
Primary climate perils	Drought Excessive Rainfall Flood

Insurance System Summary

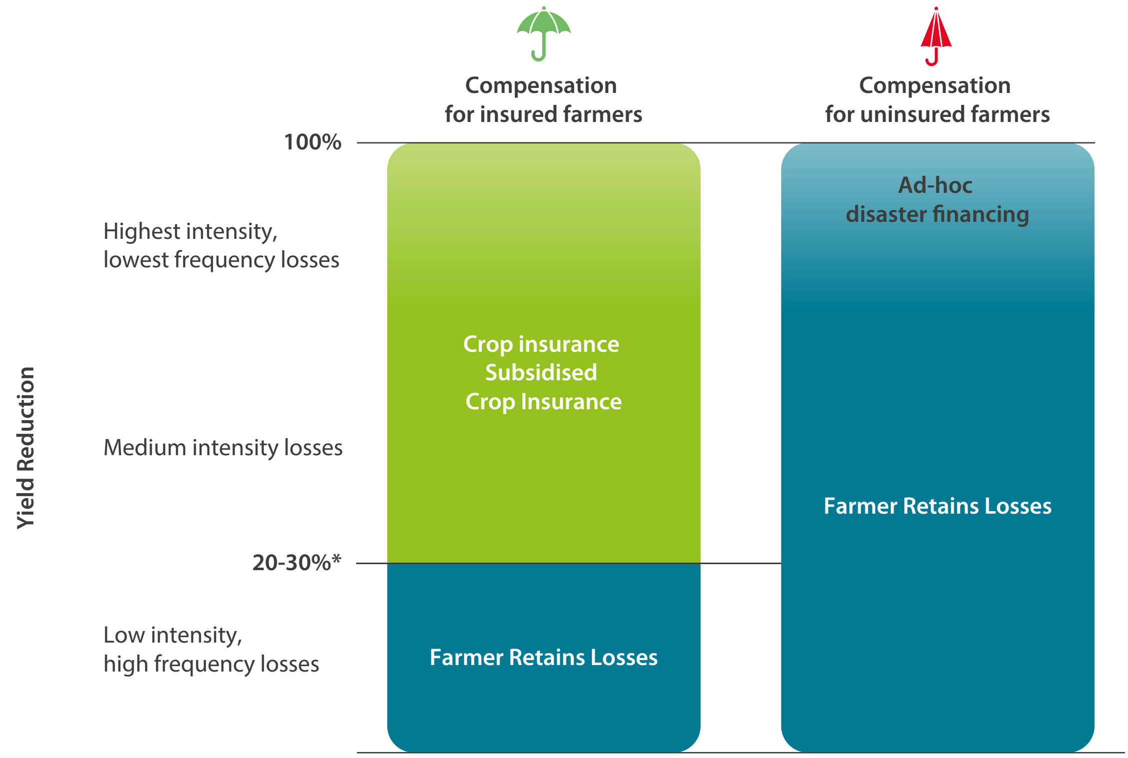
Perils insured	Hail, drought, frost, storms, and flood
Crops insured	Cereals, corn, potatoes, sugar beets, wine grapes, fruit, winter wheat, grassland and vineyards.
Compulsory insurance (by crop or peril)	No
Overall Insurance penetration	Approximately 50% of cultivated area
Average loss ratio	80-90%
Number of insurance companies	One
% of premium subsidised	Approximately 55% of premiums by member state
Public sector risk pool within the insurance system	No

120 European Commission (2021b), Statistical Factsheet Austria.
121 Ibid.

Structure of the insurance system and observations to date

Insurance system structure

Figure 40: Schematic of Agricultural Insurance Layering in Austria.



Source: Authors.

* Retained loss varies by crop and peril type. Values may only be insured up to a defined EUR /ha amount, deductibles and indemnifications vary.

** Uninsured farmers do not receive ah-hoc payments for risks for which insurance is available. Ad-hoc payments cover only 'uninsurable' risks'.

Austria's agricultural insurance system balances private sector disciplines with well-established public sector support. At its core is the Austrian Hail Insurance Company (Österreichische Hagelversicherung), a mutual, non-profit organisation established in 1946. Its longstanding relationships with the government and farmers make it the most significant underwriter in the market, covering over 50% of Austria's UAA. The system provides protection against 11 major perils including hail, drought, flooding, frost and storms, offering comprehensive multi-peril coverage.[122]

The insurance system is structured as a PPP, leveraging public subsidies to ensure affordability and accessibility. Farmers are required to cover approximately 45% of premium costs, while the remaining 55% is subsidised through public funds (half of the premium subsidy comes from the budget of the respective federal state). This framework has resulted in high insurance penetration, with about 60% of arable land insured. Due to digitalization and rapid data exchange with the Agricultural Market Agency, claims can be processed and paid out within two days, ensuring high cost efficiency.[123]

122 Interview with Austrian Hail Insurance.
123 Ibid.

Other public funds in Austria for disaster finance that are not part of the insurance system structure

Austria's CAT Fund is a pivotal mechanism for disaster finance, supporting crop insurance premiums and risk management initiatives beyond the agricultural sector. The fund invests in preventative measures such as avalanche and flood protection and provides financial aid during emergencies. This results in a robust safety net for Austrian farmers, reducing the economic impact of natural disasters and enhancing the resilience of the agricultural sector.

Examples of severe loss years

a. 2018

The extreme drought in 2018, caused between EUR 230 and EUR 270 million of agriculture losses. No specific figures on total insurance payouts are available though high insurance penetration rates (50% of the UAA) suggest a substantial portion of these losses were protected.

b. 2021

Severe hailstorms in June 2021 were the most expensive event for Austrian insurers in the last 20 years. Wiener Städtische Versicherung (Vienna Insurance Group) reported more than 48 000 claims, with total losses amounting to nearly EUR 200 million. Similarly, Oberösterreichische Versicherung (Upper Austrian Insurance) handled approximately 16 500 claims, disbursing over EUR 160 million for storm damage.

Risk Based Assessment: current conditions and 2050

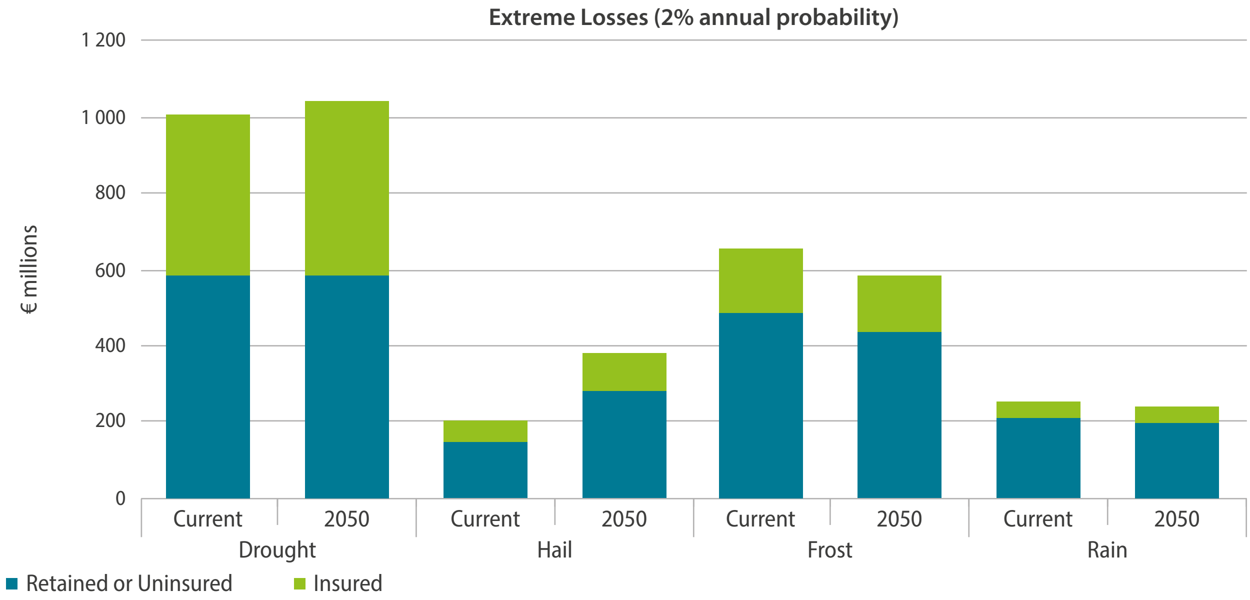
a. Protection gap and primary perils for extreme losses

The current 1-in-50 PMLs for drought, hail, rain and frost are approximately EUR 1.5 billion in Austria. For extreme loss years the protection gap for primary perils is expected to be 60%- 85%.

The drought PML is approximately EUR 1 billion under the current climate, with only a slight increase in losses expected under the SSP5-8.5 scenario. More drought losses could be compensated by insurers as most of these are expected to exceed farmer deductibles.

The current 1-in-50 hail PML is approximately EUR 200 million, but this may increase by 87% to EUR 385 million by 2050. Notably, estimates of 1-in-50-year frost PMLs for 2050 are expected to decrease by approximately 10% under the SSP5-8.5 climate scenario. Although catastrophic losses may reduce, financial pressures would still apply to farmers and insurers through the increase in frequent losses.

Figure 41: Risk layering for extreme (1-in-50 year) losses (2 % annual probability) – Austria.



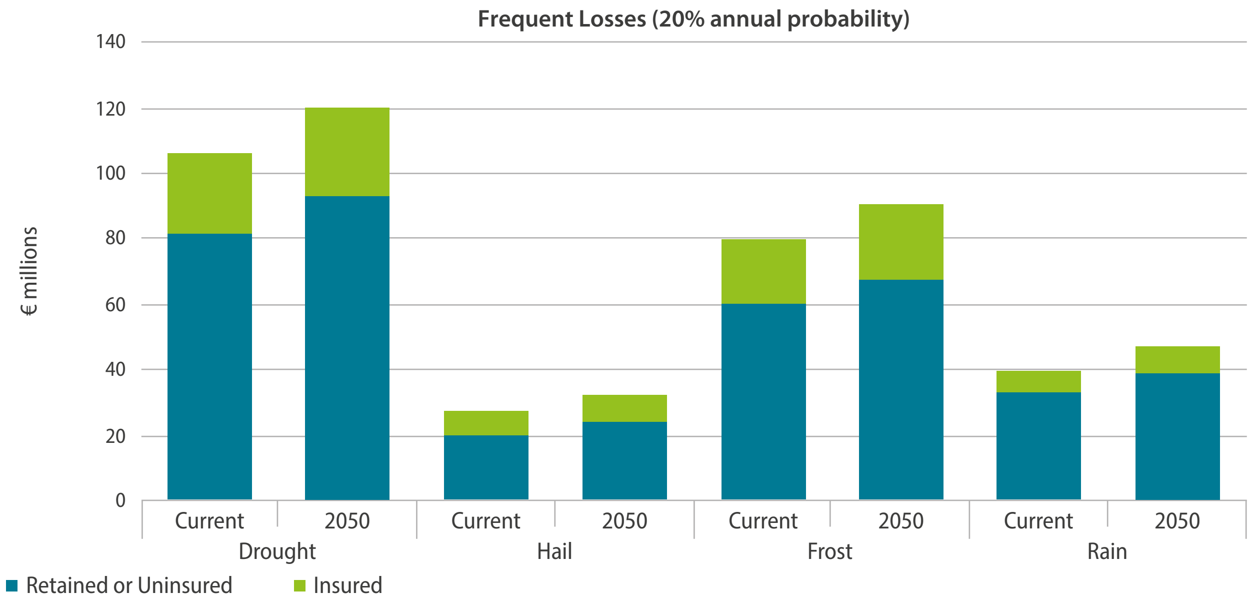
Source: Authors.

b. Protection gap and primary perils for frequent losses

Across the primary perils, drought is the primary peril for crops in Austria, with 75-85% of frequent possible current losses uninsured or retained by farmers. By 2050, frequent losses from drought are expected to increase by some 14%, falling on both insurers and farmers.

While extreme frost events could decrease by 2050, more frequent (1-in-5-year) losses could increase around 13% by 2050.

Figure 42: Risk layering for frequent (1-in-5 year) losses (20 % annual probability) – Austria.



Source: Authors.

Spain

Key reference information

Agriculture as % of GDP	2.34 %[124]
Agriculture % of national employment	3.8 % of national workforce[125]
Agriculture as % of exports	19.2 % of total export[126]
Major crops (share of overall agricultural output)	20%Vegetablesand horticultural products 19% Fruit 9% Cereals 4% Forage plants 4% Olive oil
Primary climate perils	Drought, heatwaves, frost, hail, wildfires, excess rainfall, flooding

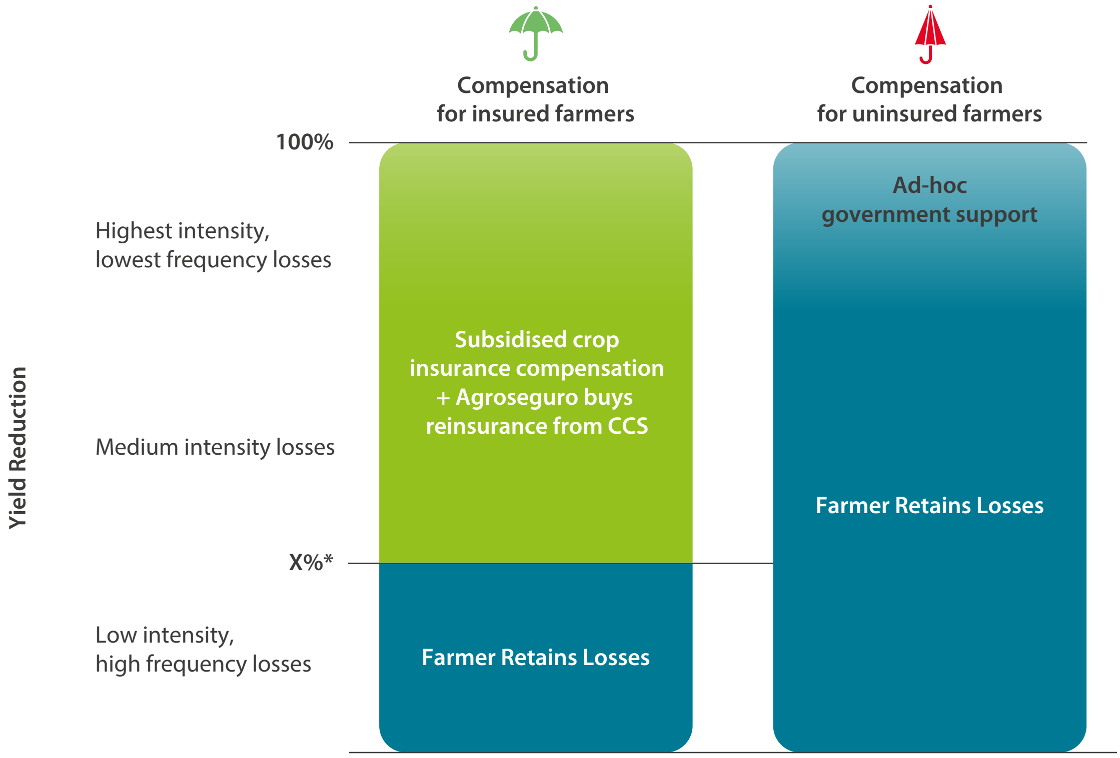
Insurance System Summary

Perils insured	Hail, drought, frost, storms, wildfires, pests
Crops insured	Widespread coverage available through 45 products: 29 for crops (including cereals, fruits and nuts, viticulture; vegetables), 12 for livestock production, 3 for aquaculture production, 1 for forestry production
Compulsory insurance (by crop or peril)	No
Overall Insurance penetration	Over 50% overall, with significant variations between crops[127]
Average loss ratio	Above 100% in recent years
Number of insurance companies	16 operating as a co-insurance pool through Agroseguro system
% of premium subsidised	Approximately 50% by Member States (Additional insurance products may exist outside the PPP model - not documented in this analysis)
Public sector risk pool within the insurance system	Public sector provides premium subsidies to producers and reinsurance protection to Agroseguro's risk pool through CCS

124 Statista (2023), Distribution of gross domestic product (GDP) across economic sectors in Spain.
125 TheGlobalEconomy.com (n.d.) Spain: Employment in agriculture.
126 European Commission, (2023g), Statistical Factsheet Spain.
127 Instituto Nacional de Estadística (2022), Agrarian Census. Year 2020.

Structure of the insurance system and observations to date

Figure 43: Schematic of Agricultural Insurance Layering in Spain.



Source: Authors.

*Insured losses are compensated to the farmer by Agroseguro in full based on the policy conditions (e.g. deductibles). Agroseguro purchases reinsurance from CCS for catastrophic losses.

Established in 1978, the Spanish agricultural insurance system is one of the most developed in the world and the most comprehensive in the EU. The system is a public private partnership integrating government oversight and administration, public subsidies and guarantees with private insurance expertise and distribution, and active farmer input through associations.[128]

Its three main components are the Entidad Estatal de Seguros Agrarios (ENESA), Agroseguro and the Consorcio de Compensación de Seguros (CCS).

Agroseguro is the operational hub, managing insurance policy design, pricing and conditions, risk assessments and claims protocols. It operates through a consortium of 16 private insurance companies that distribute these policies and collectively underwrite risks to crops, livestock, aquaculture and forestry within the Agroseguro system. Premiums and claims are pooled, with individual insurers sharing liabilities proportional to their participation. Agroseguro also conducts actuarial studies, adjusts premiums and maintains reserves for high-claim years.[129]

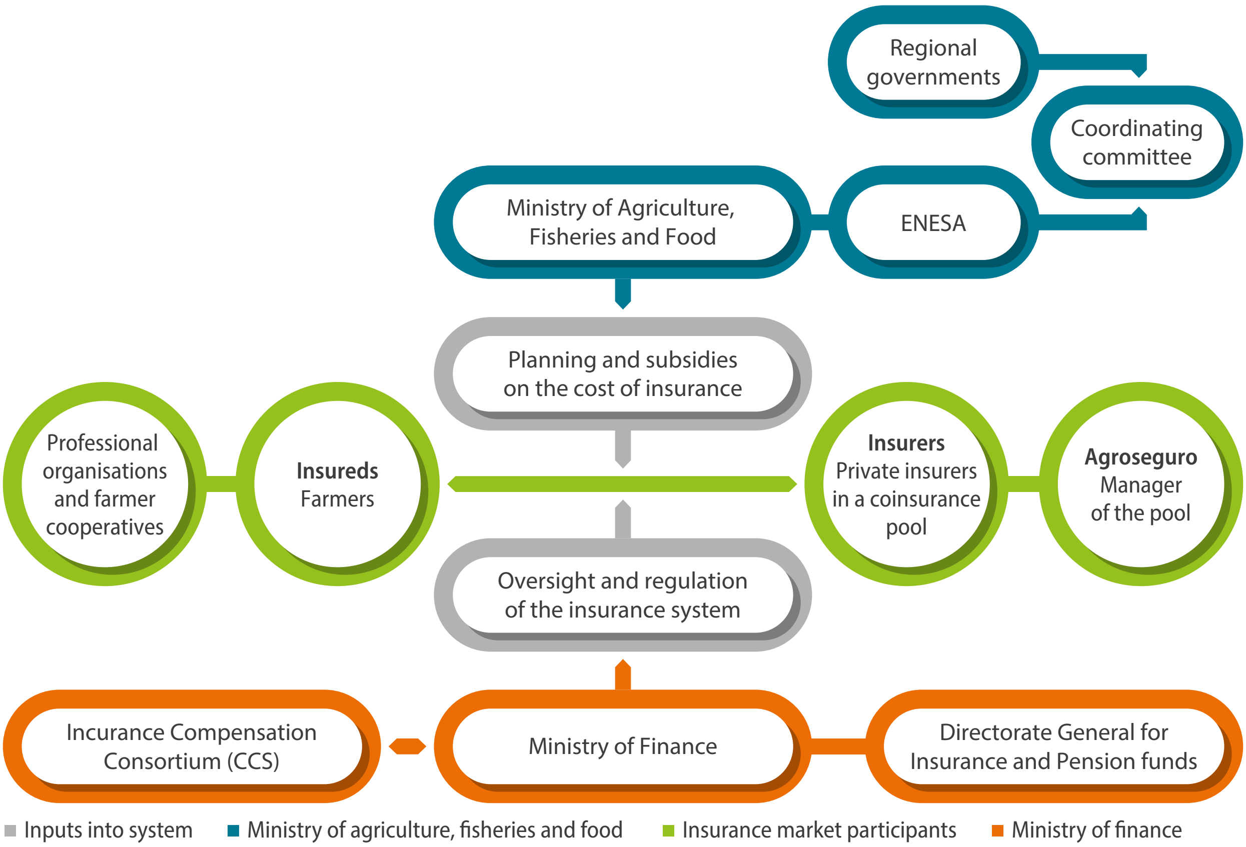
ENESA, a government body within the Ministry of Agriculture, Fisheries and Food, sets policy objectives, allocates subsidies to reduce premiums and guides product development and standards. Though Agroseguro operates independently, ENESA ensures alignment with broader agricultural policy goals, often encouraging new insurance products for specific crops or emerging risks. Subsidies are channelled through Agroseguro, not directly to farmers, to reduce premiums and ensure affordability.

128 Interview with Mapfre Re.
129 Agencia Estatal Boletín Oficial del Estato (2023), Boletín Oficial del Estado: viernes 29 de diciembre de 2023.

The CCS is the Government backed reinsurer for natural catastrophes across the Spanish insurance sector and provides protection for extreme agricultural losses that exceed Agroseguro's own capacity. The Consorcio is mandated to enable general insurance market solvency for natural catastrophe and operates beyond the agricultural sector alone. The Consorcio is mainly funded through mandatory surcharges on general insurance policies, but in the case of agriculture, no reinsurance surcharge is applied to farmers. Agroseguro is the policyholder and pays the full reinsurance premium to CCS. Through its expertise on major risks and losses, CCS collaborates on rate-setting and oversees claims management for catastrophic losses.[130]

The Spanish model's success is rooted in strong public-private coordination, adaptable policy design and high farmer trust. Agroseguro's ongoing refinement of insurance products and its response to emerging risks have maintained its relevance and effectiveness.

Figure 44: Schematic of Spanish Agricultural insurance system. Adapted.



Source: Antón, J. and S. Kimura (2011)

Agriculture insurance penetration averages 50%, with significant variation across crops and regions. For instance, coverage exceeds 80% for fruit trees and arable crops but is around 14% for olive trees. This disparity stems from olive trees' historic resilience to climatic events and their perception as lower risk, though emerging evidence of vulnerability to climate suggests this may change.

130 Agencia Estatal Boletín Oficial del Estado (2019) Orden ECE/497/2019, de 22 de abril, por la que se establece el sistema de reaseguro a cargo del Consorcio de Compensación de Seguros para el cuadragésimo Plan de Seguros Agrarios Combinados.

Examples of Severe loss years

a. 2017

The drought of 2017 led to crop and livestock losses totalling EUR 3.6 billion.[131] Agroseguro paid claims of EUR 227 million,[132] and state support stepped in with emergency irrigation works and the suspension of some fees, tariffs and taxes.[133]

b. 2022

In 2022 Spain experienced an extreme drought that was estimated to cause between EUR 8 billion and EUR 10 billion in losses to crops such as almonds, corn, sunflower and olives.[134] Agroseguro paid EUR 118 million to farmers and ranchers for drought damage.[135]

National ad-hoc aid of EUR 2 billion to respond to the drought emergency was allocated, of which EUR 276.7 million included direct payments and support for livestock, dairy and bee farmers.[136]

Additional damage from frost, which impacted fruit and almond trees in April 2022 led to payouts from Agroseguro of EUR 259 million. An additional EUR 165 million was paid after storms including hail and excess rain, leaving the annual total at EUR 793.3 million.[137]

c. 2023

2023 resulted in the highest ever payout, EUR 1.24 billion, of the Spanish agriculture insurance system: drought (EUR 496 million); hail, rain and wind (EUR 375 million); frost EUR 61 m and livestock (EUR 163 million).

Agroseguro expressed this as a loss ratio of 169% in a statement at the 2024 Annual Shareholders Meeting.[138] The organisation had issued over 360 000 insurance policies, with total premiums reaching a record EUR 1.01 billion, an annual rise of 16%, including EUR 508 million (52%) supported by public subsidies from national and regional governments.

These premiums produced EUR 16.9 billion of insurance protection with over 80% covering industrial crops, cherries, nuts and vegetables; 3% of this coverage protected wine, citrus, strawberries and arable crops.[139]

"The Consorcio de Compensación de Seguros, the system's reinsurer, paid out almost EUR 470 million euros of the 1 241 billion euros of claims, with EUR 59 million of reinsurance premium".[140]

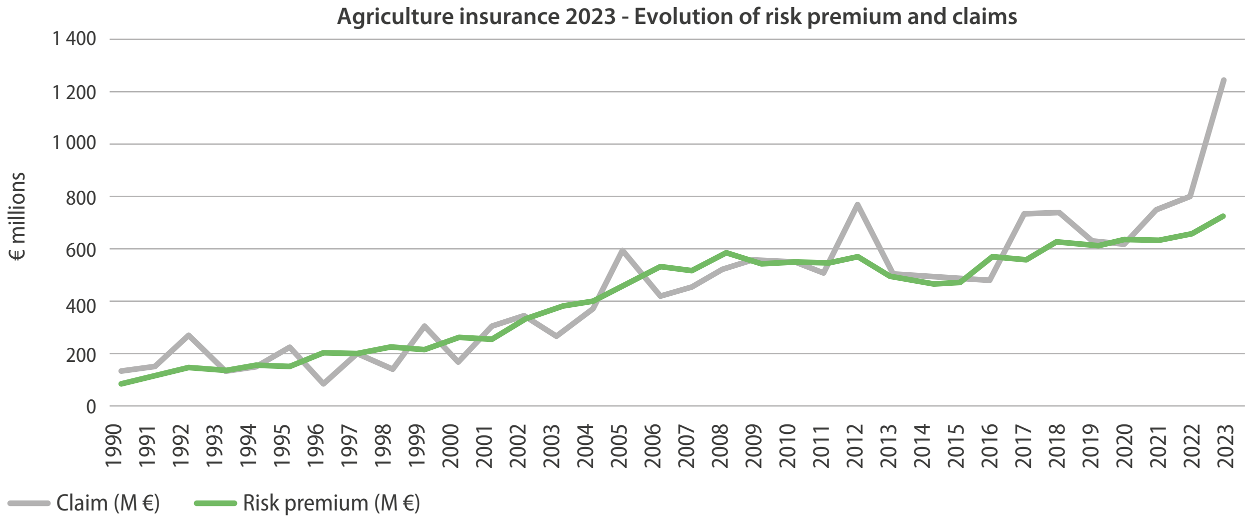
The record 2023 drought affected over 2.3m ha of land, 90% of which was identified as insured.[141] The overall national figures for agricultural losses to the 2023 drought are difficult to ascertain from published sources, but there is evidence of reduced yields of up to 50% in key crops, such as cereals, olives and vines.[142] The Andalucia government evaluated the cost of the 2023 drought at EUR 4.2 billion alone.[143]

Reports indicate that the 2023 drought had wider consequences than production losses alone and caused an employment reduction in the agriculture sector of over 50 000 people.[144]

131 Ministerie van Landbouw, Visserij, Vodselzekerheid en Natuur (2017). Drought fully hits main Spanish agro-food sectors.
132 Agroseguro (2023a), The Spanish Agricultural System.
133 La Moncloa (2017), El Gobierno aprueba nuevas medidas para paliar la sequía.
134 Agroberichten Buitenland (2024a), Spain: Agriculture drought losses to reach 10 billion.
135 Agroseguro (2023a), The Spanish Agricultural System.
136 Agroberichten Buitenland (2023) Spain: Two billion euros' aid to fight against drought.
137 Agroseguro (2024a), Agricultural insurance claims set a historical record in 2023: 1.241 billion euros.
138 Agroseguro (2024b), Agroseguro's General Shareholders' Meeting approves the accounts for financial year 2023.
139 Agroseguro (2023), The Spanish Agricultural Insurance System.
140 Agroseguro (2024b), Agroseguro's General Shareholders' Meeting approves the accounts for financial year 2023.
141 Agroseguro. (2023), The Spanish Agricultural Insurance System.
142 COAG Servicios Centrales (2023), Impacto de la sequía en el sector agrario.
143 Sur in English (2024), The drought crisis takes its toll in Andalucía: 4.2 billion euros in 2023 and even more this year.
144 La Vanguardia. (2024). Spain loses 51,000 jobs in agriculture in two years due to the drought.

Substantial claims were also made for storm losses, including hail and rain, of some EUR 375 million. An additional EUR 61 million in frost compensation was also paid in 2023.[145]

Figure 45: The Spanish Agricultural Insurance System: Main Characteristics and Figures, 2023.



Source: Agroseguro.[146]

Risk-based assessment: current conditions and 2050

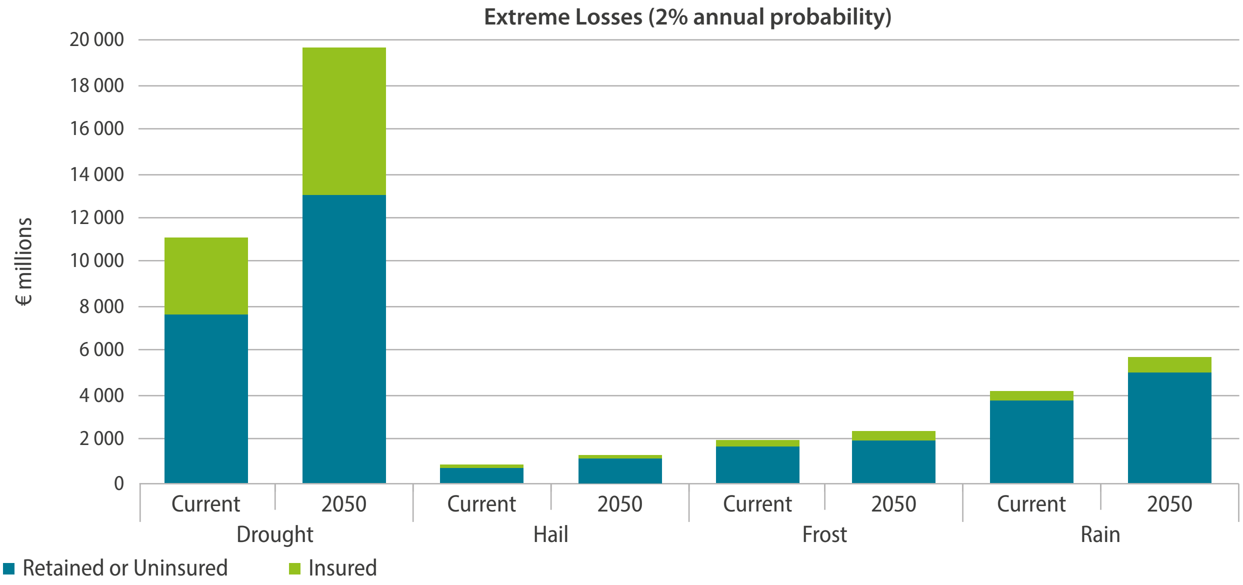
a. Protection gap and primary perils for extreme losses

Aggregate losses from drought, hail, rain and frost with a 2% annual probability of occurring are currently about EUR 12.4 billion. During these catastrophic loss years, the overall protection gap across primary perils is expected to be 60 to 80%.

Drought drives these losses, with the current 1-in-50 year PML reaching EUR 11 billion. Under the SSP5-8.5 scenario, such PMLs are expected to increase by 75% to almost 20 billion by 2050.

145 Agroseguro (2024a), Agricultural insurance claims set a historical record in 2023: 1.241 billion euros.
146 Agroseguro (2023), The Spanish Agricultural Insurance System.

Figure 46: Risk layering for extreme (1-in-50 year) losses (2 % annual probability) – Spain.

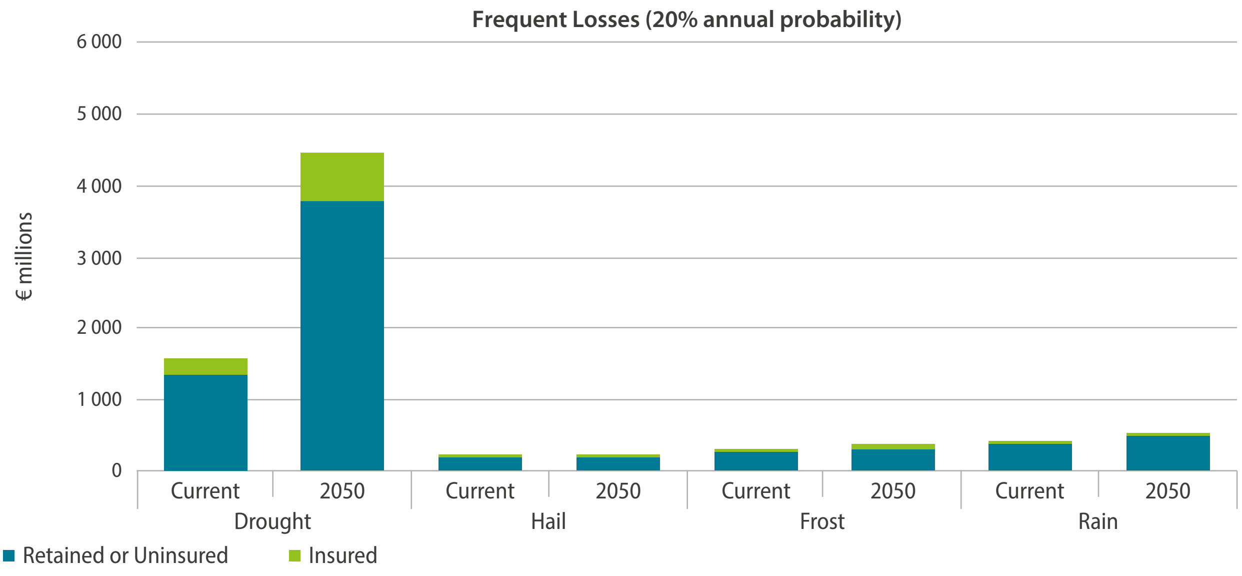


Source: Authors.

b. Protection gap and primary perils for frequent losses

Across the primary perils, approximately 85% of frequent (1-in-5-year) losses are currently expected to be uninsured or retained by farmers. Drought is also the primary peril for frequent crop losses in Spain, with 1-in-5-year PML estimated to reach approximately EUR 1.6 billion. By 2050, frequent losses from drought are expected to nearly triple to EUR 4.5 billion with the majority falling to farmers.

Figure 47: Risk layering for frequent (1-in-5 year) losses (20 % annual probability) – Spain.



Source: Authors.

Part 3.6 Public private partnership systems
Countries using EU funding to subsidise premiums
Case studies: France, Germany, Italy, Netherlands, Poland, Romania

France

Key reference information

Agriculture as % of GDP	3.3%
Agriculture % of national employment	2.6%
Agriculture as % of exports	14.8%[147]
Major crops (share of overall agricultural output)	15% Cereals 15% Wine 9% Vegetables and horticultural products 8% Forage plants[148]
Primary climate perils	Flood Excess Rain Drought Hail Frost

Insurance System Summary

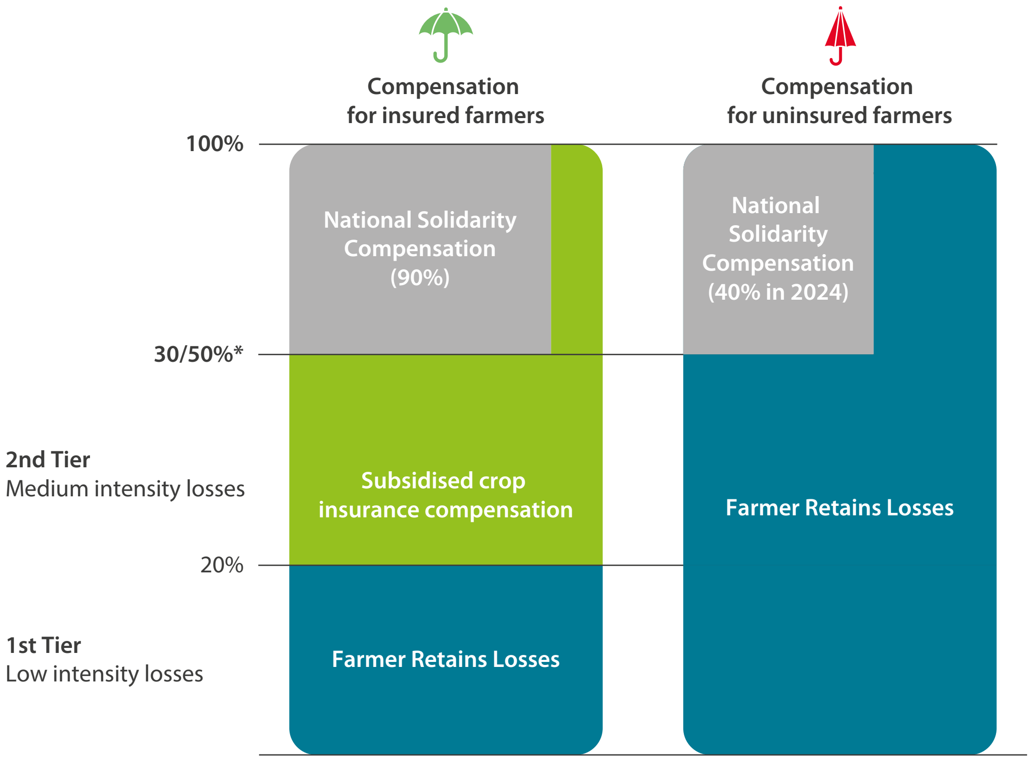
Perils insured	Multi Risk Hail and Storm
Crops insured	More than 70 different insurable crops
Compulsory insurance (by crop or peril)	No
Overall Insurance penetration	Moderate – 30%
Average loss ratio	High- 90%[149]
Number of insurance companies	Two major insurers (70% market) + smaller insurers
% of premium subsidised	<70%
Public sector risk pool within the insurance system	Yes

147 European Commission (2021c), Statistical Factsheet France.
148 Ibid.
149 France Assureurs (2023), L'assurance agricole en 2023.

Structure of the insurance system and observations to date

Insurance system structure

Figure 48: MRC insurance layers under the 2022 reforms.



Source: Authors.

* There are different threshold levels to trigger national solidarity for different products: 30% (meadows, orchards, horticulture) and 50% (field crops, vineyards).

The first crop insurance companies were founded during the 19th century. Initially the market was purely private with coverage offered only on a named peril basis (hail, wind, fire, frost). In 1964, a severe drought led to the creation of a public compensation fund (Fonds National de Garantie des Calamités Agricoles, FNGCA) through which the government could provide disaster financing to farmers.

Multi-peril insurance coverage expanded in 2005 with the introduction of government subsidies of up to 65% of insurance premiums, supported by CAP funds. More private comprehensive insurance cover (Multi Risques Climatiques, MRC) enabled changes to ex-post disaster payments in 2010, when a new National Fund for Risk Management in Agriculture (Fonds National de Gestion des Risques en Agriculture, FNGRA) replaced the FNGCA. This precluded claims to State disaster funds for losses resulting from privately insurable hazards.

System Reforms

New regulations in May 2022 extended risk sharing between farmers, insurers and the government. These promote the uptake of insurance by gradually removing support provided to uninsured farmers. The system includes:

FNGRA – providing ex-post payments after catastrophic events to insured farmers, as well as to uninsured farmers but at a reduced rate.

MRC (multi-risk) premium subsidy – MRC premiums are subsidised by 70%, funded through the CAP European Agriculture Guarantee Fund.[150] For the period 2023-2027, EUR 156 million to EUR 216 million are budgeted annually,[151] steadily increasing in anticipation of more insurance penetration in the coming years. Premium subsidies are only available on policies meeting certain requirements, such as the breadth of perils covered, surface areas under cultivation and the use of the five-year Olympic yield as the baseline for losses.

- **Tier 1** *yield losses up to 20%:* The farmer is responsible for low intensity risks.
- **Tier 2** *yield losses above 20% and below 30-50% depending on the crop:* For medium-intensity risks, compensation is paid by the subsidised multi-peril crop insurance or is a farmer's responsibility if they have not purchased insurance.
- **Tier 3** *yield losses exceeding 30-50% depending on the crop:* For exceptional risks, the National Solidarity Fund (FNS) compensates losses. If the farmer is insured, the state compensates 90% of Tier 3 losses and the insurer covers the remaining 10%. If the farmer is uninsured, the state compensates 45% of those losses, with the rest borne by farmer.

Private insurers and reinsurance – Although policy conditions are heavily influenced by the subsidy eligibility requirements, private insurers are free to competitively price and sell MRC and other named peril policies directly to farmers or producer groups.

Compensation for uninsured farmers is planned to be reduced progressively from 45% in 2024 by 5% each year to incentivise the uptake of insurance.

It is too early to assess if the new system incentivises uptake of subsidised MPCI. No up-to-date insurance penetration statistics are yet available, but Groupama received 14% more agricultural premiums in France in 2023 which indicates increased uptake.[152]

The major French reforms to its agricultural insurance were the first major realignment with new CAP insurance support frameworks and were followed by others including Poland and Italy. The performance of this leading French approach will be keenly observed by other countries and EU institutions.

The French insurance market exhibits concentration with Groupama, holding a market share of around 50%, and Crédit Agricole's Pacifica approximately 20%. A group of insurers make up the remainder of one of the largest markets in Europe, with around EUR 820 million in annual premiums. However, the penetration rate is limited to around 13% of farms[153] equivalent to around 30% of UAA, because insurance is preferred by larger farms.

150 France Government (2023), Notice d'assurance récolte.
151 European Commission (2024a), CAP 2023-2027 Strategic Plan – France.
152 Groupama (2024a), FY2023 annual results of the Groupama Group Results.
153 Bank of France (2024), Agricultural Insurance Report.

Examples of severe loss years

a. 2017

Unusually warm weather in March meant vegetation was in growth stages when late spring frosts hit, affecting viticulture and horticulture in France.[154] Agricultural producers faced losses of EUR 980 million. Groupama met approximately EUR 95 million of claims, while FNGRA provided EUR 72.9 million in compensation, suggesting a sizeable protection gap despite the availability of public funds.

b. 2018

In May 2018, hailstorms severely impacted 17 000 hectares of vineyards in the Bordeaux and Charente-Cognac regions. Specifically, nearly 7 100 hectares of vineyards in Bordeaux and over 10 000 hectares in the Charente-Cognac basin were damaged by violent hailstorms. This event resulted in damage to 4 - 5% of the Bordeaux vineyards,[155] with Groupama paying over EUR 76 million in claims.

Risk-based assessment: current conditions and 2050

Protection gap and primary perils for extreme losses

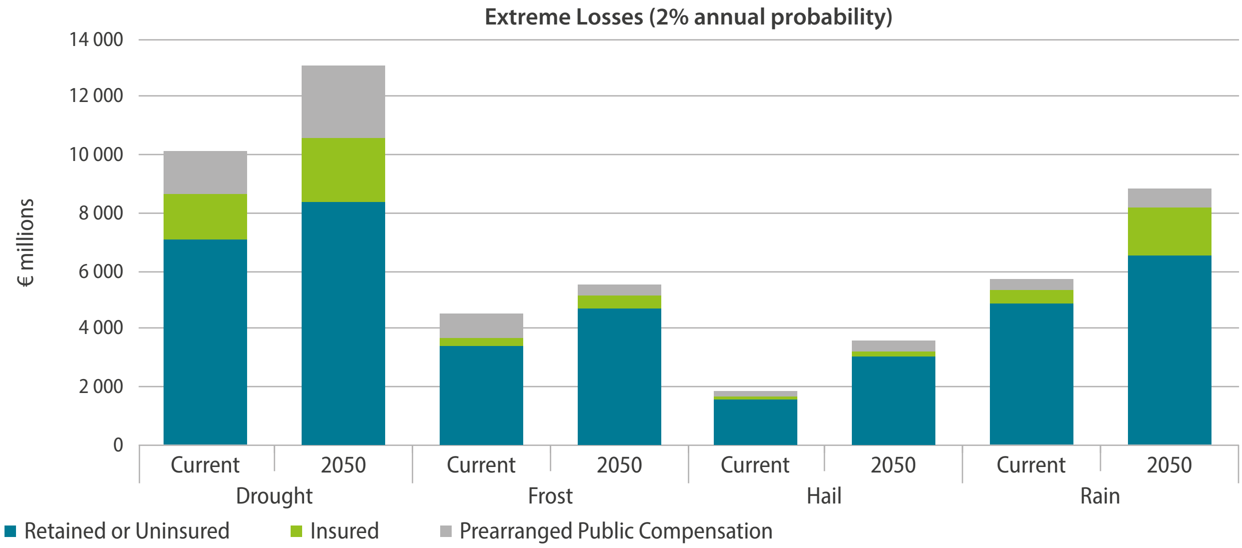
Aggregate PML from drought, hail, rain and frost for 1-in-50 year events are approximately EUR 12.4 billion. At current levels of insurance penetration across these driving perils, between 70-85% of losses are expected to fall on farmers.

The current 1-in-50 year drought only PML is approximately EUR 10 billion and expected to increase by 29% to EUR 13 billion by 2050. Under current market conditions, this would lead to an absolute increase in the size of losses for all parties in the risk layering structure of the French system, through a greater proportion of losses, driven by crop losses, exceeding the 20% yield threshold. The proportion of losses falling to farmers would decrease, remain similar for insurers but increase for the national solidarity fund.

The excess rainfall 1-in-50 PML is approximately EUR 5.7 billion , and expected to increase by 54% to EUR 8.9 billion by 2050. Under current programme conditions, an increase in the severity of yield losses triggers a greater proportion of insurance payments.

154 Munich Re (2018), Spring frost losses and climate change.
155 La Croix (2018) La grêle endommage 17 000 hectares de vignes.

Figure 49: Risk layering for extreme (1-in-50 year) losses (2 % annual probability) – France.

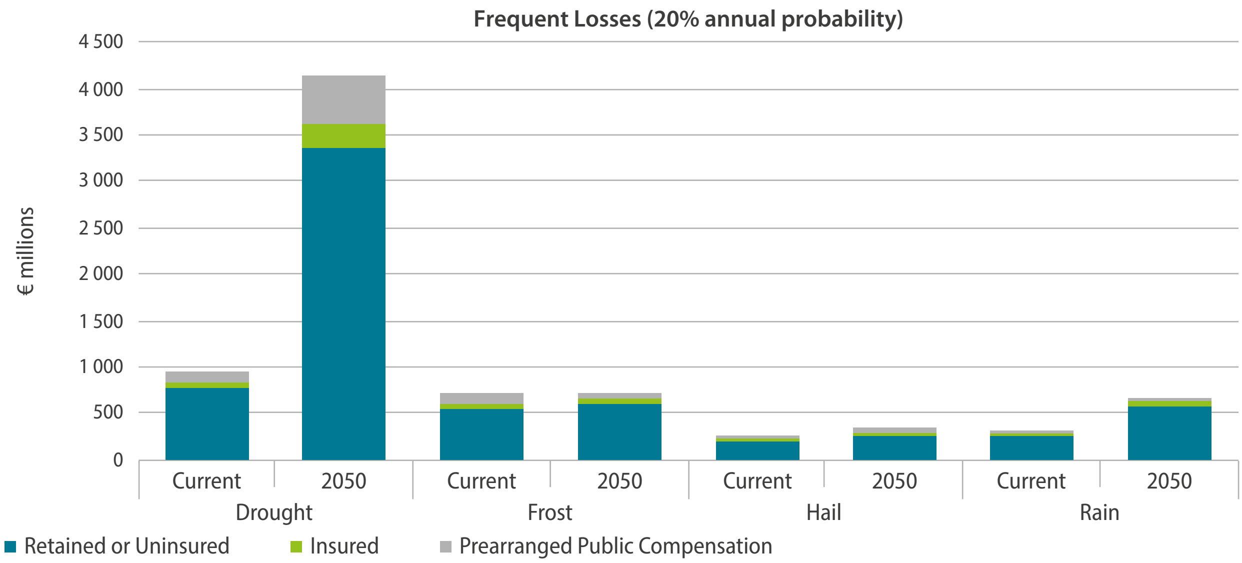


Source: Authors.

Protection gap and primary perils for frequent losses

Drought is the primary peril for crop losses in France, with the current 1-in-5 year PML being almost EUR 1 billion. However, by 2050, frequent losses from drought are expected to increase to over EUR 4 billion. While this will significantly impact farmers, the expected losses falling to the state solidarity fund are expected to increase fourfold.

Figure 50: Risk layering for frequent (1-in-5 year) losses (20 % annual probability) – France.



Source: Authors.

Germany

Key Reference Information

Agriculture as % of GDP	0.72%[156]
Agriculture % of national employment	1.24% of national workforce[157]
Agriculture as % of exports	6.2% of total export[158]
Major crops (share of overall agricultural output)	11% Vegetables and horticultural products 13% Cereals 9% Forage plants 8% Industrial crops 5% Potatoes
Primary climate perils	Drought, heatwaves, flooding, storm, hail, frost

Insurance System Summary

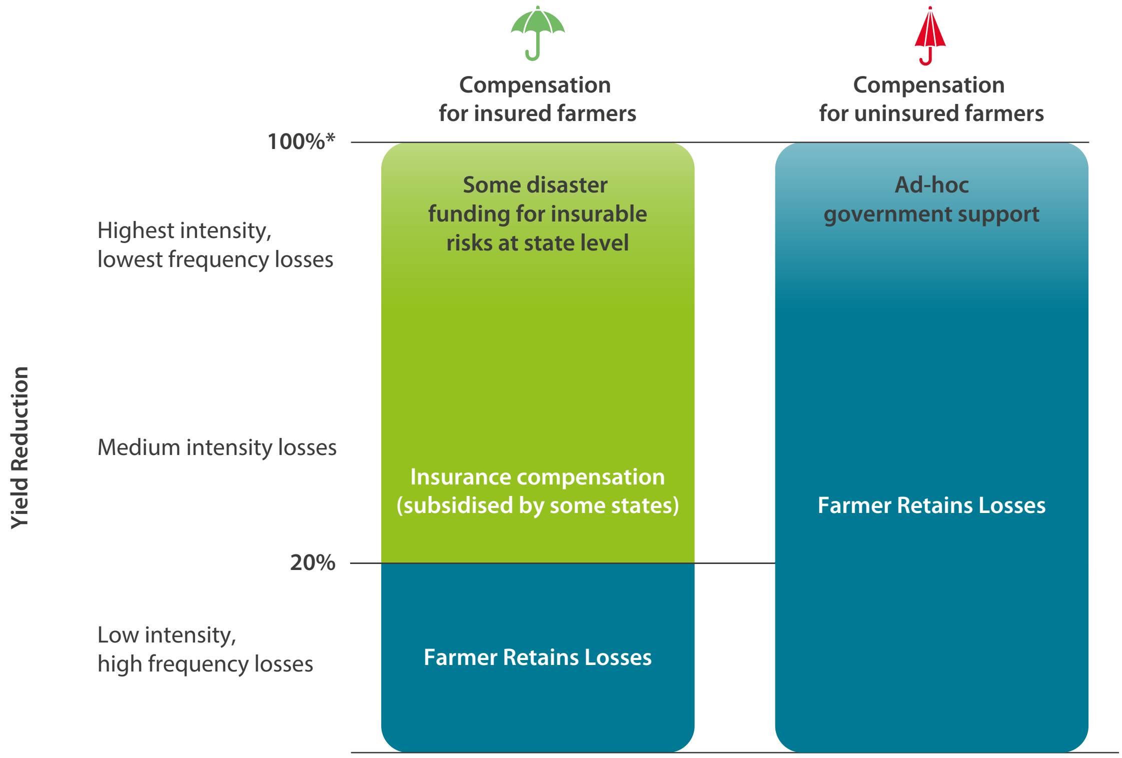
Perils insured	Hail, Drought, Floods, Frost, storms
Crops insured	Arable crops, Fruit and Vegetables, Specialty crops
Compulsory insurance (by crop or peril)	No
Overall Insurance penetration	Approximately 55% for covered crops
Average loss ratio	70-80%
Number of insurance companies	Six
% of premium subsidised	Varies between Länder
Public sector risk pool within the insurance system	No

156 Germany - Agriculture, Value Added (% Of GDP) - 2024 Data 2025 Forecast 1991-2023 Historical.
157 Germany - Employment In Agriculture (% Of Total Employment) - 2024 Data 2025 Forecast 1983-2022 Historical.
158 European Commission (2021c), Statistical Factsheet Germany.

Structure of the insurance system and observations to date

Insurance system structure

Figure 51: Schematic of Agricultural Insurance Layering in Germany.



Source: Authors.

Germany's agricultural insurance system is based on traditional named-peril products, particularly hail insurance which covers a substantial portion of insurable land and up to 75% of key crops.

The system is underpinned by mutual insurance companies and cost-effective administration, providing reliable coverage for local risks and a foundation for long-term operational stability. However, while the system addresses well-established risks, such as hail, it may not yet be responding sufficiently to emerging threats. For example, one critical issue is the limited coverage of systemic risks such as drought. Drought insurance currently accounts for less than 1% of insured arable land, reflecting high premiums and an absence of consistent nationwide subsidies.

Other public funds in Germany for disaster finance that are not part of the insurance system structure

In addition to agricultural insurance, Germany relies on state-level disaster relief to address uncovered catastrophic losses. Each state can provide financial aid for agricultural disasters, using its own budget. The federal government intervenes only in national-scale emergencies, providing ad hoc aid based on the severity of the event.

Examples of severe loss years

a. 2003

The summer of 2003 was the warmest in Germany since records began with 25% less precipitation than normal[159] and much of southern and central Germany experienced a severe drought. Total annual losses to agricultural production were EUR 2 billion, of which EUR 1.6 billion was caused by drought.

Most farmers were unprotected and highly sensitive to losses. State and federal governments made EUR 72 million in emergency, ad-hoc payments[160] leaving a protection gap of over EUR 1.5 billion (95%).

b. 2009

Regionally dispersed spring hailstorms, especially in the southwest, saw 15cm hailstones[161] leading to higher-than-average losses to agricultural production of EUR 299 million. This drove record claims paid by Vereinigte Hagel totalling EUR 168.3 million, the highest in over ten years, taking the company's loss ratio to 117%.

c. 2017

Milder weather in the spring coupled with a late frost in April caused damage especially for fruit and wine growers with apple harvests hit by as much as 40% in some areas.[162] Losses were estimated at EUR 345 million of which only around EUR 15 million were insured due to high premiums.[163] Some ad-hoc government support was granted at state level, with Baden Württemberg and North Rhine-Westphalia providing EUR 54.44 million.[164] The protection gap was approximately EUR 276 million (80%).[165]

d. 2018

A severe drought in 2018 produced agricultural losses of EUR 5.53 billion.[166] Only 5,000 hectares of arable land area was insured for drought through multi risk insurance policies, just 0.03% of the UAA.[167] Farmers could not deal with the losses, leading to an official request from the German Farmers Union (*Deutsche Bauernverband*, DBV) for EUR 1 billion in ad hoc support. Federal and state governments made EUR 292 million available to affected farmers.[168]

159 Die Bundesregierung (2003) Hitzewelle und Dürre.
160 Stern (2018), 2003 half der Staat schon einmal - so viel Geld bekamen die Bauern damals.
161 Deutscher Wetterdienst (2009), Klimastatusbericht 2009.
162 Deutsche Rück (2017) Sturmdokumentation 2017: 400.000 Tonnen weniger Äpfel.
163 Munich Re (2017), Schäden durch Spätfrost und der Klimawandel – Nur scheinbar ein Widerspruch.
164 Baden-Württemberg, Ministerium für Ernahrung, Ländlichen Raum und Verbraucherschutz (2017) Kabinett beschließt Ad-hoc-Hilfen nach Jahrhundertfrost im April diesen Jahres.
165 Landesregierung Nordrhein-Westfalen (2018) Land stellt fünf Millionen Euro für Frostschäden-Hilfen bereit.
166 Prognos (2022) Schäden der Dürre- und Hitzeextreme 2018 und 2019.
167 Gesamtverband der Versicherer (2018) Klima: Auf dem Trockenen.
168 European Foundation for the Improvement of Living and Working Conidtions (2024) Federal state-states administrative agreement on drought relief 2018.

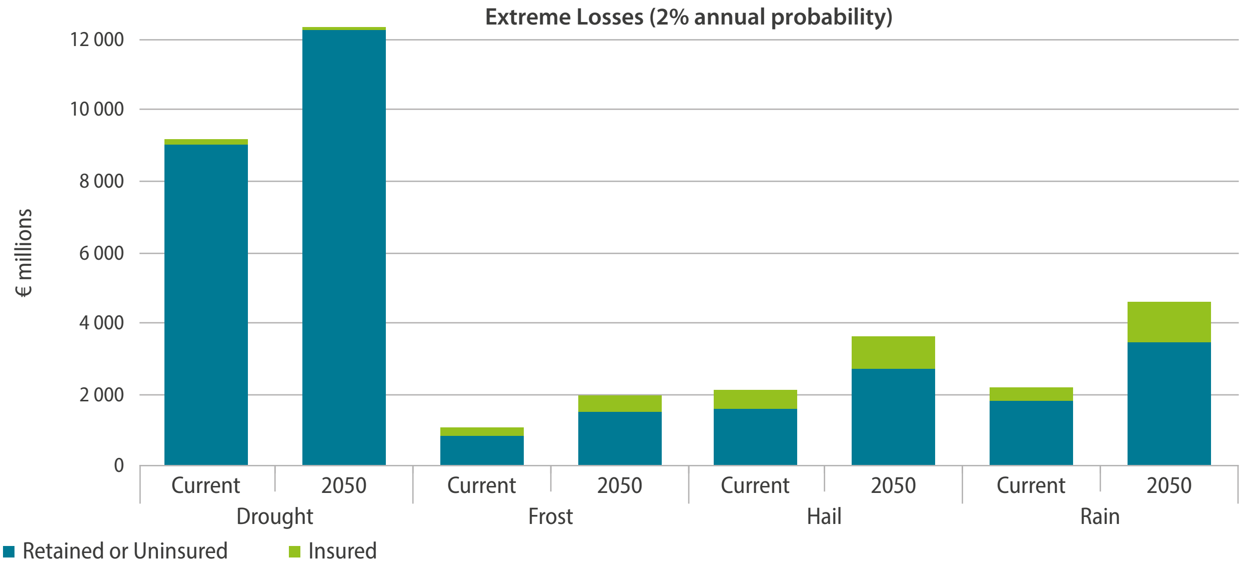
Risk Based Assessment: current conditions and 2050

a. Protection gap and primary perils for extreme losses

The current drought 1-in-50 PML is approximately EUR 9 billion. Low coverage in Germany means almost all drought losses would fall on farmers. Losses are expected to increase by 35 % to EUR 12.3 billion under the SSP5-8.5 scenario. Under current levels of insurance penetration, the majority of these losses fall on farmers.

The current 1-in-50-year PML for excess rainfall only is approximately EUR 2.1 billion and expected to more than double by 2050 to EUR 4.5 billion. Coverage for this peril is more common and under current insurance market conditions would lead to an increased proportion of losses compensated by insurers.

Figure 52: Risk layering for extreme (1-in-50 year) losses (2 % annual probability) – Germany.



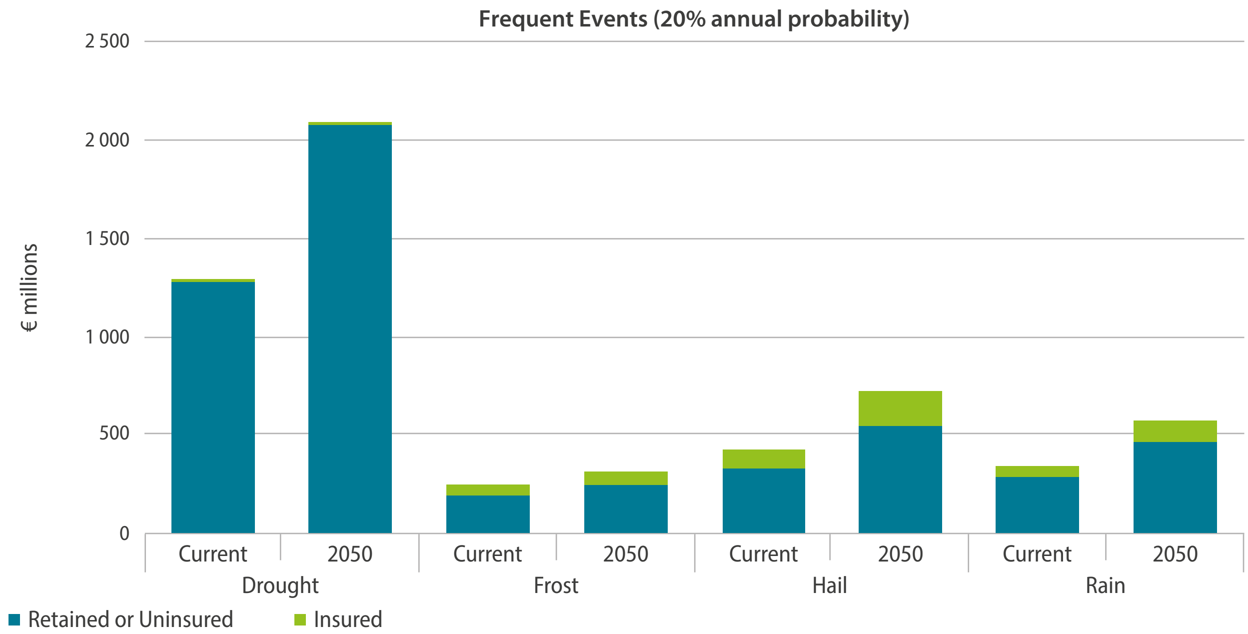
Source: Authors.

b. Protection gap and primary perils for frequent losses

Drought is also the primary peril for frequent crop losses in Germany. Due to limited availability of drought cover, almost all frequent drought losses fall on farmers.

The current 1-in-5-year drought PML is EUR 1.3 billion, and is expected to increase by 62% to EUR 2 billion by 2050.

Figure 53: Risk layering for frequent (1-in-5 year) losses (20 % annual probability) – Germany.



Source: Authors.

Italy

Key Reference Information

Agriculture as % of GDP	2% of GDP [169]
Agriculture % of national employment	3.7% of national workforce[170]
Agriculture as % of exports	10.6% of total export[171]
Major crops (share of overall agricultural output)	20% Vegetables and horticultural products 18% Wine 11% Fruit 8% Industrial crops 8% Cereals 3% Olive oil [172]
Primary climate perils	Frost, hail, drought, flooding

Insurance System Summary

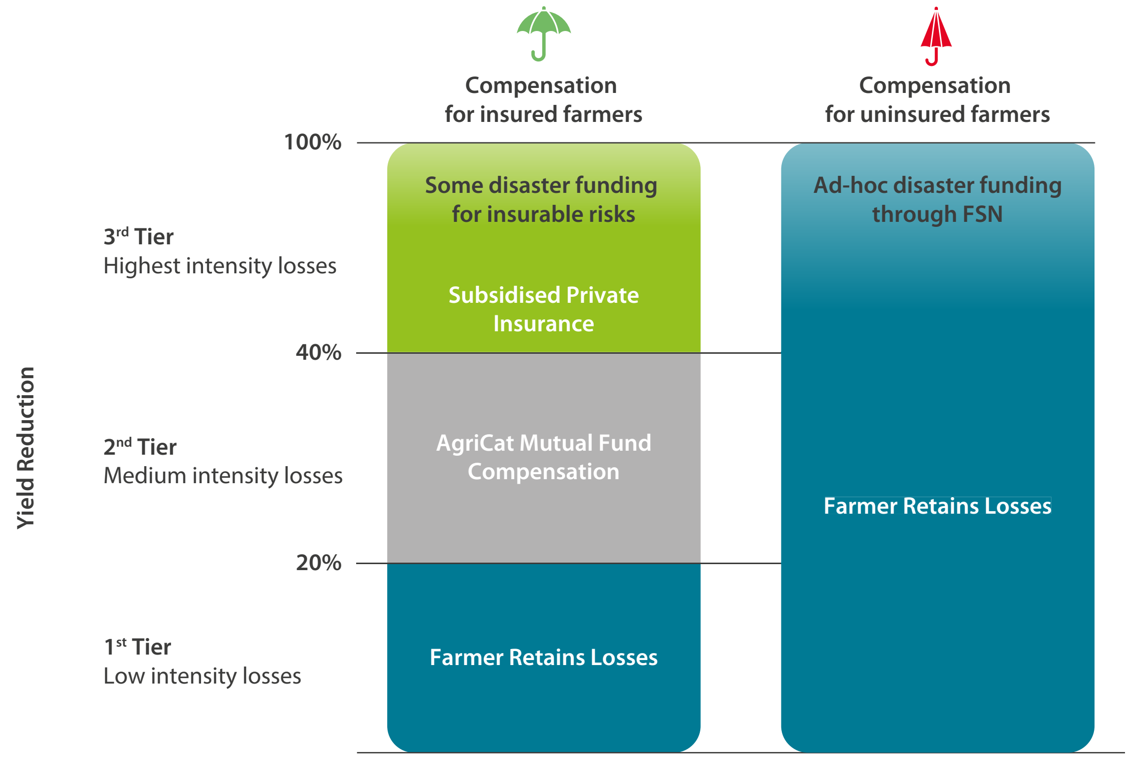
Perils insured	Hail, Frost, Drought, Flooding, Excess Rain, Wind
Crops insured	Vineyard and grapes, Fruit, Olives, Vegetables, Grain and field crops
Compulsory insurance (by crop or peril)	No
Overall Insurance penetration	10%
Average loss ratio	70-80%
Number of insurance companies	25
% of premium subsidised	50-70%
Public sector risk pool within the insurance system	No

169 European Commission. (2023d). Italy: CAP Strategic Plan 2023-27.
170 Economies (n.d.) Italy – Empstatloyment In Agriculture (% Of Total Employment).
171 TheGlobalEconomy.com (n.d.) Spain: Employment in agriculture.
172 European Commission (2021f), Statistical Factsheet Italy.

Structure of the insurance system and observations to date

Insurance system structure

Figure 54: Schematic of Agricultural Insurance Layering in Italy.



Source: Authors.

The Italian agricultural insurance system is a hybrid model integrating private insurance, subsidies and mutual funds to address diverse risks faced by farmers. Private insurers offer a range of policies, including single-peril and multi-peril, but only multi-peril insurance is eligible for government subsidies, a shift introduced in 2013 to encourage broader adoption. Subsidies, funded through CAP typically cover 50–70% of premiums, making insurance more accessible for farmers. Despite this, as of 2023, only about 10% of Italy's cultivated agricultural area and 9% of farms were insured, reflecting persistent barriers to widespread uptake.[173]

The Agricat Fund, introduced in 2022, is now central to the system, providing compulsory catastrophe coverage for farmers receiving CAP direct payments. Agricat acts as a safety net for higher-frequency, severe weather events such as frost, hail and drought, covering losses between 20% and 40% of historical yields. Losses above these are the purview of private insurance. This 'first risk layer' approach aims to stabilise the insurance market and attract reinsurance, but Agricat's early performance faced several challenges. In 2023, it paid out just EUR 26 million of an expected EUR 250 million, and had limited impact on overall insurance penetration. Additionally, multiple severe weather events have raised concerns about the fund's capacity to support them, prompting discussions about expanding its scope to broader catastrophic risks.[174] In 2025, new experimental simplified policies were introduced with different criteria from previous policies, aligning with Agricat to offer an additional level of coverage starting in 2024.

173 Oxford Academic. (2023). Italian subsidised crop insurance: What the role of policy changes.
174 Stakeholder interview.

The system covers multiple types of crops, including major staples and high-value crops such as olives and fruit. However, insurance penetration is concentrated in northern regions such as Lombardy, Veneto and Emilia-Romagna, where commercial agriculture is more developed. Insured values have grown steadily, reaching EUR 10 654 million in 2023, but the total insured land area has stagnated, and the number of insured farms has declined. These trends highlight geographic and structural disparities in the system's reach.[175]

Extreme weather events have posed significant challenges to the system's sustainability. Catastrophic frost and hailstorms in 2017, 2019, and 2023 resulted in substantial payouts, straining insurers and raising premiums. For example, the 2023 frost severely impacted high-value crops such as fruit, exposing gaps in frost insurance coverage despite ongoing efforts to expand options. Such events have underscored the need for greater innovation in risk management tools.[176]

The broader insurance framework is complemented by mutual funds, introduced during the 2014–2020 CAP programming period. These funds provide cooperative-based protection against non-catastrophic risks such as pest infestations and plant diseases, compensating members for losses exceeding 30% of historical income. Another initiative, mutual income funds, introduced in 2013, stabilises farm incomes in response to economic fluctuations or external shocks such as market crises or extreme weather. Key agricultural regions including Lombardy, Emilia-Romagna, Veneto, and Trentino have been particularly active in promoting these funds where farmers pool resources and share risks as an alternative to traditional insurance. Adoption remains limited due to administrative complexities and low awareness.[177]

Other Public Funds for Disaster Finance

Italy uses additional public funds such as the National Solidarity Fund (FSN) to complement subsidised insurance. This fund provides ad hoc compensation for extraordinary risks or events not covered by standard insurance. The Agricat fund, supported by CAP financing, is a buffer for high-frequency catastrophic events, but there are concerns about its sustainability as mentioned above. In 2023, widespread flooding highlighted the need for stronger disaster finance mechanisms, as existing systems failed to cover many losses.

Stress tests in recent years have revealed systemic vulnerabilities, particularly the limited capacity of private insurers to cover catastrophic risks.[178] Rising reinsurance costs and restricted coverage terms have exacerbated the issue, while increasing reliance on public funds raises questions about long-term fiscal sustainability.

175 ISMEA (2023) Campagna 2023: cosa dicono i numeri.
176 Ibid.
177 Stakeholder interview.
178 IAIS (2023) A call to action: the role of insurance supervisors in addressing natural catastrophe protection gaps.

Examples of severe loss years

a. 2023

In May 2023, devastating floods struck Emilia-Romagna, one of Italy's most important agricultural regions. Heavy rainfall led to widespread flooding, submerging over 5 000 farms and causing extensive damage to orchards, vineyards and field crops. Agricultural losses were estimated to exceed EUR 1.5 billion. The floods also severely impacted infrastructure, homes and businesses, placing a significant financial burden on local communities.[179]

Flood insurance coverage in Italy was low, with protection concentrated in northern regions, mainly for high-value or high-risk crops. As a result, many farmers faced extensive costs for recovery.[180] Condifesa Romagna, a non-profit association supporting agricultural risk management, provided EUR 3.9 million in compensation to affected members.

However, this covered only a fraction of the total losses. In response to the disaster, the European Commission allocated EUR 1 billion from its crisis fund, co-financed by the Italian government, to support agricultural businesses.[181] Additional measures included EUR 50 million from Law 100/2023 to address damage in the livestock sector and EUR 15 million from the Emilia-Romagna Region's Rural Development Programme to restore production sites.[182]

Risk Based Assessment: current conditions and 2050

a. Protection gap and primary perils for frequent losses

The current 1-in-50 PML for drought, hail, rain and frost is approximately EUR 13.4 billion. Across these primary perils, 65-85% of losses are expected to fall on farmers.

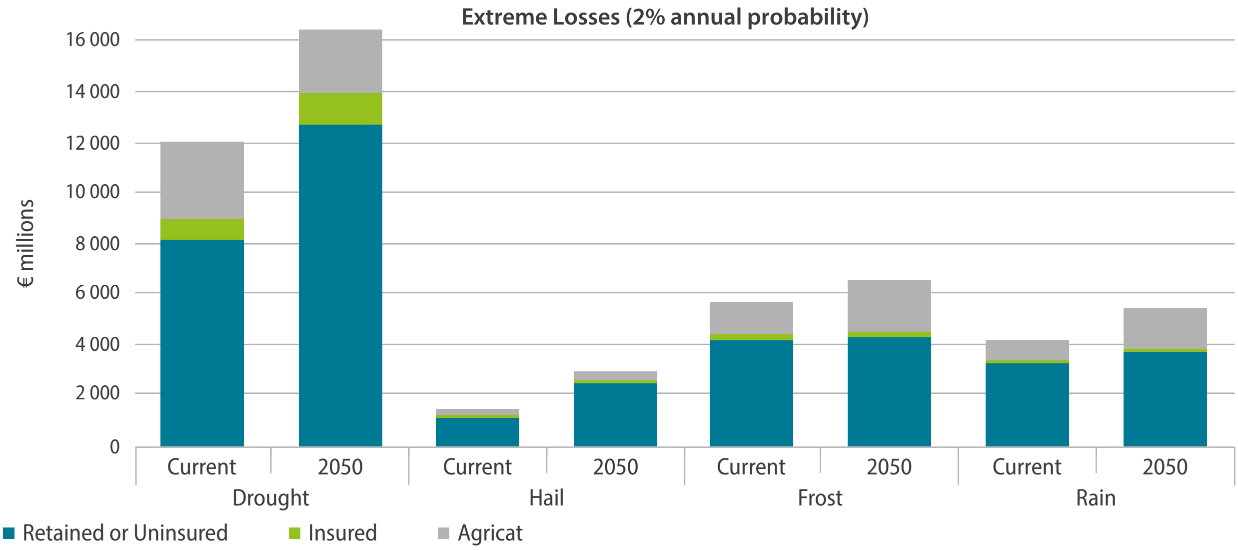
The current drought 1-in-50 PML is approximately EUR 12 billion, and expected to increase by 37% to EUR 16.7 billion by 2050. Under current insurance market conditions, this would lead to an absolute increase in the size of losses for all parties in the risk layering structure of the Italian system.

Our analysis shows that under the current low rate of insurance penetration, farmers would see an increased proportion of losses falling on them. Agricat, which covers the mid-layer of the risk structure, is expected to see a moderate decrease in the proportion of losses it compensates, while the proportion would remain similar for insurers. This highlights the benefit of increasing insurance coverage for higher yield loss layers.

Across other driving perils our analysis suggests that, under current conditions, the Agricat fund could in future provide a substantial proportion of prearranged compensation for crop losses. This means that despite low insurance penetration rates, the overall estimated protection gap for primary perils is similar to other Member States.

179 Guy Carpenter. (2023a). Italy Emilia-Romagna Flood 2023-05.
180 Industry Intelligence. (2023). EU allocates €EUR 1.03B from Solidarity Fund for flood recovery in five countries; Italy, Slovenia receive largest shares for 2023 disaster relief.
181 Eunews. (2024, October 9). Brussels, EUR 1 billion in state aid approved for farmers affected by floods in Emilia Romagna, Tuscany, and Marche.
182 Regione Emilia-Romagna- Agricoltura, caccia e pesca (2023), Stanziati i primi 100 milioni da risorse Ue e cofinanziamento dello Stato per le imprese agricole danneggiate.

Figure 55: Risk layering for extreme (1-in-50 year) losses (2 % annual probability) – Italy.



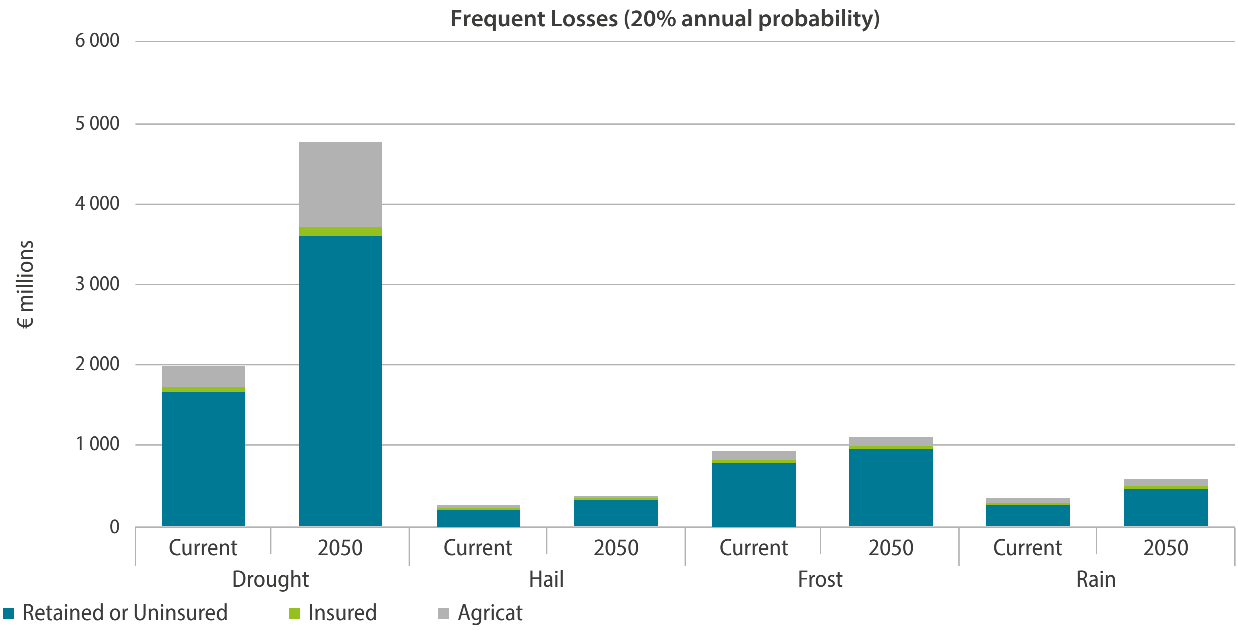
Source: Authors.

b. Protection gap and primary perils for frequent losses

Drought is the primary agricultural peril in Italy, currently expected to cause almost EUR 2 billion in losses for 1-in-5 year events. This could more than double to EUR 4.8 billion by 2050.

Under current conditions, already a greater proportion of losses are expected to fall within the Agricat layer. Although farmers are expected to hold a smaller portion of overall losses, the absolute value could double under current climate conditions.

Figure 56: Risk layering for frequent (1-in-5 year) losses (20 % annual probability) – Italy.



Source: Authors.

The Netherlands

Key Reference Information

Agriculture as % of GDP	3.2%[183]
Agriculture % of national employment	1.9%[184]
Agriculture as % of exports	16%[185]
Major crops (share of overall agricultural output)	41% Vegetables and horticultural products 7% Potatoes 3% Fruit 3% Forage Plants 1% Industrial Crops
Primary climate perils	Excess rainfall Hail Drought

Insurance System Summary

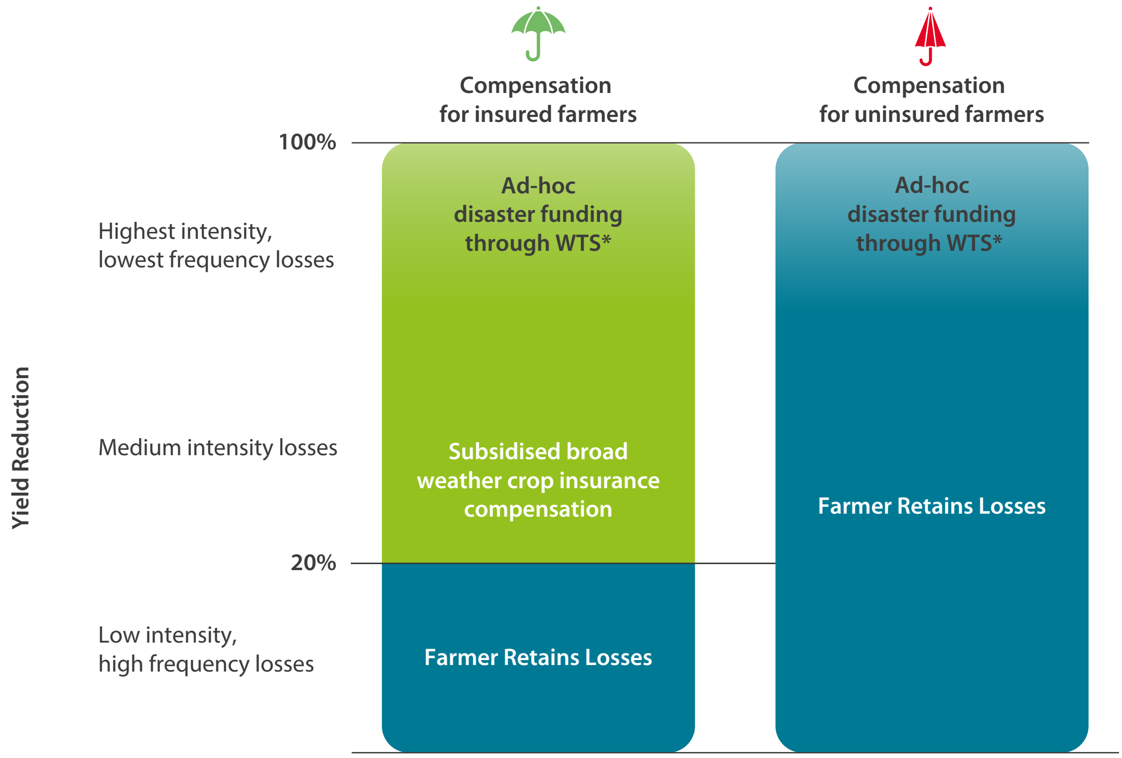
Perils insured	Comprehensive weather insurance Named peril (hail) insurance
Crops insured	• Field Crops • Fruit • Flower Bulbs • Flowers • Forestry
Compulsory insurance (by crop or peril)	No
Overall Insurance penetration	Approximately 8%[186] (30% for some crops and perils)
Average loss ratio	Unknown
Number of insurance companies	Two
% of premium subsidised	53.23%
Public sector risk pool within the insurance system	No

183 World Bank (2023), Agriculture, forestry, and fishing, value added (% of GDP).
184 World Bank (2023), Employment in agriculture (% of total employment).
185 European Commission (2023f), Statistical Factsheet Netherlands.
186 Centraal Bureau voor de Statistiek (2023), Areaal akkerbouw met 3 procent gegroeid.

Structure of the insurance system and observations to date

Insurance system structure

Figure 57: Schematic of Agricultural Insurance Layering in The Netherlands.



Source: Authors.

* Must meet defined criteria to trigger payouts from central government (risk to life and health or extensive damage to environment or assets).

The Netherlands has a highly industrialised and productive agricultural system with the second highest net value added per agricultural worker in the EU. This has been achieved through the extensive deployment of technology in Dutch farms. The Netherlands is also the most export-orientated country in the EU, second only to the US in terms of agricultural export value globally.

The Dutch agricultural insurance and risk financing system is based on a PPP. Contributions to agricultural insurance premiums have been co-financed by the State budget and CAP funds through Pillar 2 Rural Development Funds since 2015. Prior to 2010, only hail insurance was available on the private insurance market, complemented by ad-hoc support from the Dutch government after extreme weather events.[187] Under that system, high premiums for private multi-peril crop insurance hindered uptake among farmers, which limited the private market.

187 Ecorys (2024). Evaluatie van de Subsidieregeling Brede Weersverzekering.

With the introduction of premium subsidies for comprehensive weather insurance (Brede Weersverzekering, BWV) in 2010, the Dutch agricultural insurance system has broadened the perils insured and penetration rate has slowly increased. Farmers previously insured with single peril hail policies moved towards the subsidised, broader coverage.[188] The system, initially designed in collaboration with farmer organisations and the insurance industry, allows for participating insurers to formulate policy conditions freely but within BWV regulations. Currently, policies can cover losses exceeding 20% of yield to single crops planted in a contiguous area.[189] Such insurance products are eligible for a pro rata subsidy based on the annual budget. This was 63.7% of the premium in 2024.[190]

Currently, two firms, Agriver and Vereinigte Hagel, offer insurance in the private Dutch market after Agriver merged with insurer BFAO and ended almost a decade of the three firms sharing the market.[191] Both Agriver and Vereinigte Hagel are mutual insurers and operate as a duopoly.

Other public funds in the Netherlands for disaster finance that are not part of the agriculture insurance system structure

Farmers can seek compensation for losses under the Disaster Damage Compensation Act (WTS) which is not specific to agriculture and covers losses from catastrophic events.[192] An event must meet defined criteria to trigger payouts from the central government, such us constituting a major risk to life and health or causing extensive damage to the environment or assets. In the case of a disaster, the Netherlands Enterprise Agency (Rijksdienst voor Ondernemend) assesses the cause and extent of damages to advise government agencies on the impact. Victims are required to cover part of the costs and losses must be non-recoverable, unavoidable and not reasonably insurable.

This move away from ex-post funding for disaster recovery transfers a large portion of disaster recovery to the private risk markets and allows the state to plan for costs more effectively.[193]

WTS has released funds six times, with four of these involving payouts to agricultural producers. Claims made to the government under WTS for losses resulting from insurable events such as droughts have been rejected and no compensation made available.

188 Tweede Kamer der Staten-Generaal (2017), Evaluation report on the Subsidisation of Broad Weather Insurance Scheme.
189 Ibid.
190 Rijksdienst voor Ondernemend Nederland (2024), Brede Weersverzekering.
191 Nieuwe Oogst (2024), Agriver en BFAO fuseren en zijn nu samen de grootste verzekeraar.
192 Rijksoverheid (2024), Wet tegemoetkoming schade bij rampen.
193 Ministerie van Landbouw, Natuur en Voedselkwaliteit. (2024). Eindrapport Evaluatie Brede Weersverzekering.

Examples of severe loss years

c. 2012

In February 2012, the Netherlands experienced severe frost, causing significant damage, particularly to fruit. The most affected areas were Flevoland and the Noordoostpolder, though substantial losses were also reported in Betuwe, Noord-Holland, and Limburg. In pear orchards, frozen rootstocks and extensive fruit loss led to considerable financial setbacks for growers. Beyond the immediate impact in 2012, farmers faced long-term consequential damage, with weakened trees reducing yields in subsequent years.

The agricultural losses from the frost were estimated at EUR 85 million. While the risk was insurable, frost damage coverage was limited to keep insurance premiums affordable. As a result, many farmers remained financially exposed, bearing a major portion of the losses.[194]

d. 2021

In July 2021, extreme rainfall led to severe flooding in the Dutch province of Limburg, affecting multiple sectors, including agriculture. While precise data on agricultural losses remain limited, total damages in the region were estimated at EUR 400 to EUR 500 million. Farmers suffered crop losses, soil degradation and infrastructure damage, exacerbating financial vulnerabilities in the sector.

To support recovery, the Dutch government activated the Disaster Compensation Act (WTS) to provide financial assistance for uninsured damage. However, full compensation was not guaranteed and certain losses, such as business interruption, were excluded.[195]

Risk-based Assessment: current conditions and 2050

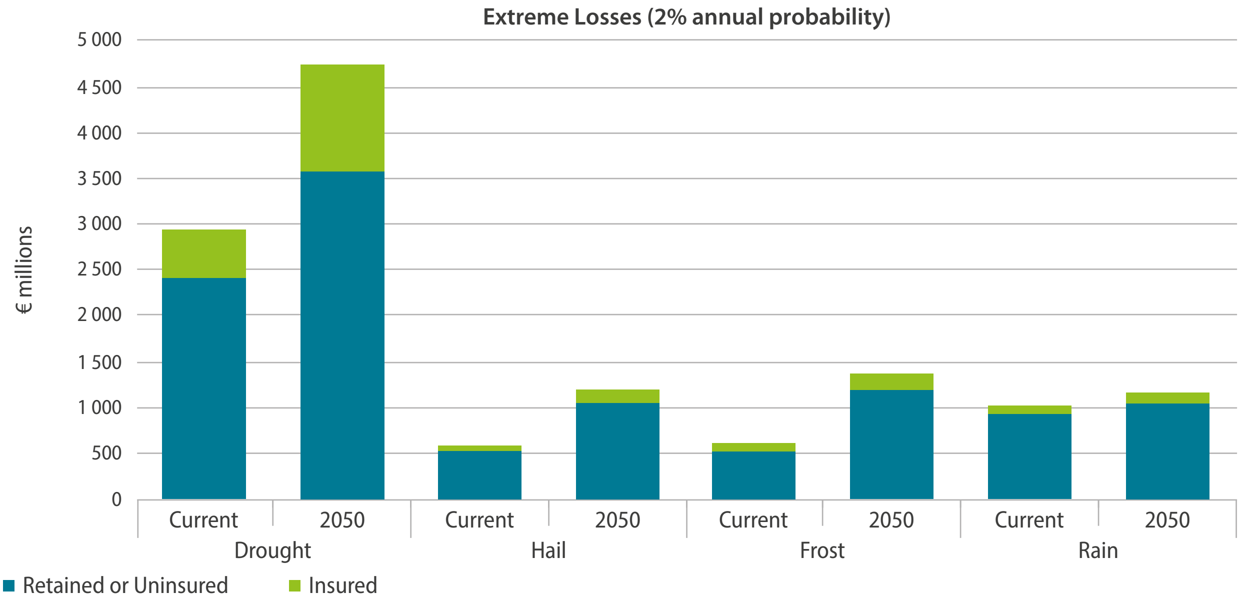
a. Protection gap and primary perils for extreme losses

The current 1-in-50-PMLs for drought, hail, rain and frost are currently in the order of EUR 4 billion in the Netherlands. The current drought 1-in-50 PML is EUR 2.9 billion and expected to increase by 62% up to 2050.

The current 1-in-50 frost and hail PMLs are each approximately EUR 600 million and expected to more than double.

194 Visser, H. (2012),The effects of climate change in the Netherlands.
195 Chubb (2021), We need to work together to create solutions for flood risk in the Netherlands.

Figure 58: Risk layering for extreme (1-in-50 year) losses (2 % annual probability) – Netherlands.



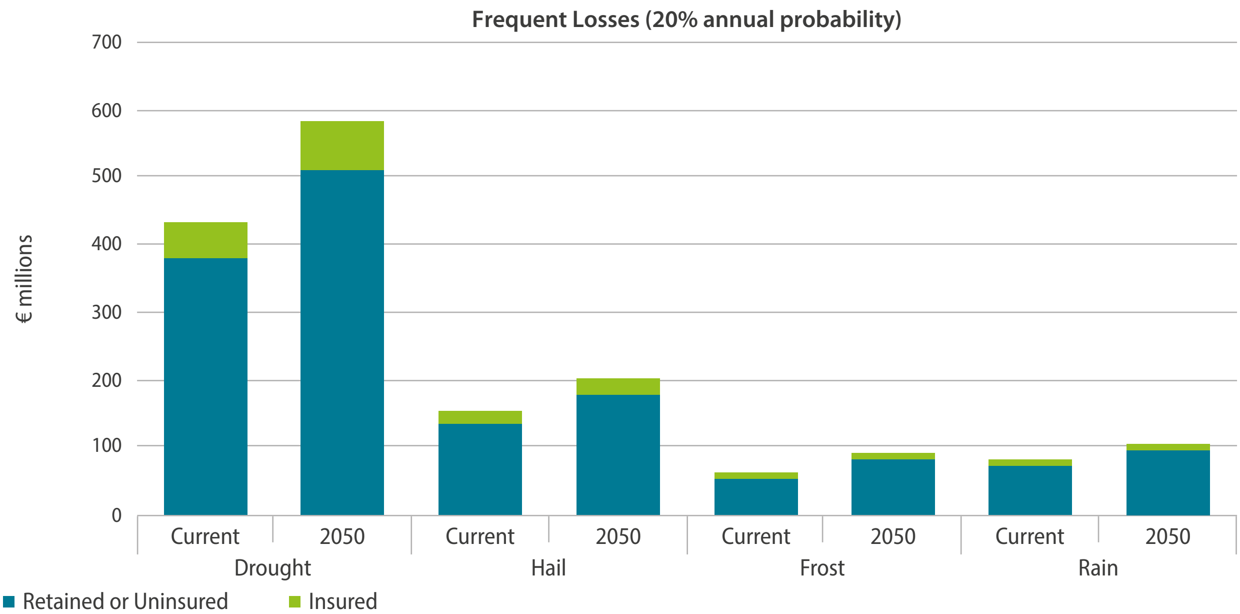
Source: Authors.

b. Protection gap and primary perils for frequent losses

In the Netherlands, the protection gap for frequent losses is estimated to be near 90%. Although insurance covers a broad range of perils, a large proportion of 1-in-5-year yield losses fall on farmers.

Drought is the primary peril for crop losses in the Netherlands. The current 1-in-5- drought PML is approximately EUR 430 million, increasing by around 35% by 2050.

Figure 59: Risk layering for frequent (1-in-5 year) losses (20 % annual probability) – Netherlands.



Source: Authors.

Poland

Key Reference Information

Agriculture as % of GDP	2.9%[196]
Agriculture % of national employment	8.25% of national workforce[197]
Agriculture as % of exports	13.4% of total exports[198]
Major crops (share of overall agricultural output)	16% Cereals 12% Vegetables and horticultural products 7% Industrial crops 5% Fruit 4% Potatoes[199]
Primary climate perils	Drought Flooding Frost Hail

Insurance System Summary

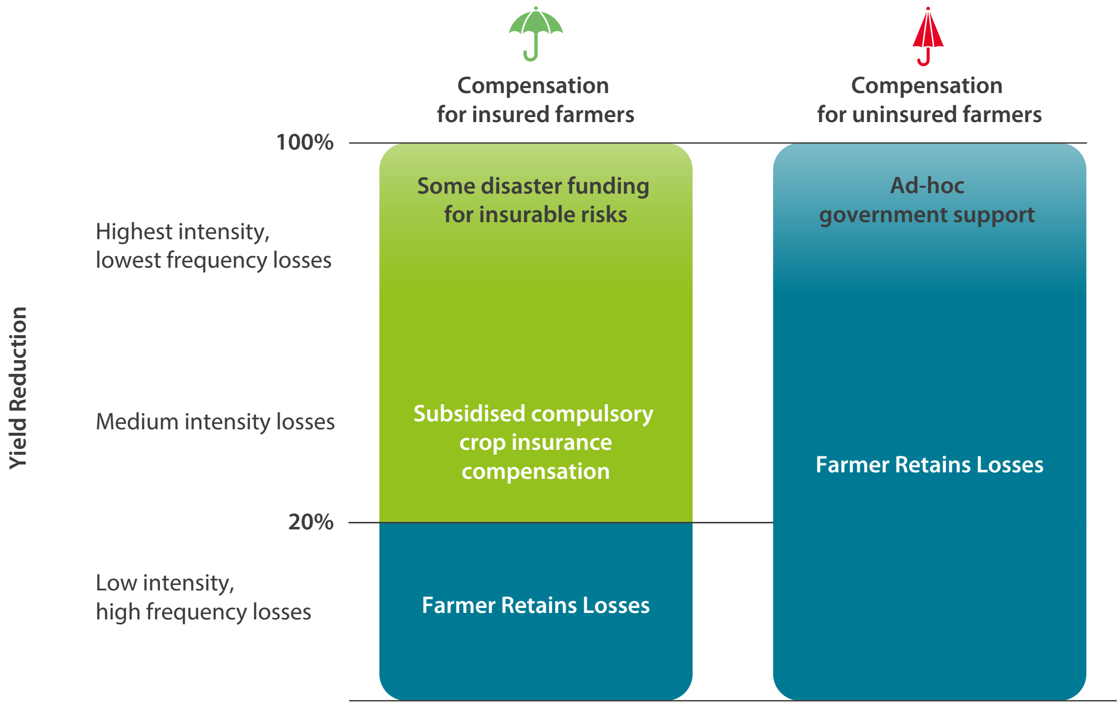
Perils insured	Hail, Frost, Drought, Storms, Flooding, Excess Rain
Crops insured	Cereals, Fruit, Vegetables, Oilseeds
Compulsory insurance (by crop or peril)	Yes
Overall Insurance penetration	Moderate – 38% of cultivated area
Average loss ratio	Approximately 60-70%
Number of insurance companies	Five
% of premium subsidised	Approximately 65%
Public sector risk pool within the insurance system	No

196 Statista (2024, August 20), Agricultural sector's share of GDP in Poland and EU 1995-2023.
197 TheGlobalEconomy.com (2022), Employment in agriculture, % of total employment in Poland.
198 European Commission (2021g), Statistical Factsheet Poland.
199 Ibid.

Structure of the insurance system and observations to date

Insurance system structure

Figure 60: Schematic of Agricultural Insurance Layering in Poland.



Source: Authors.

Poland's agricultural insurance system operates on a hybrid framework that combines mandatory and voluntary components. Specific crops and livestock must be insured to qualify for government production subsidies. Private insurers such as PZU, Warta S.A. and Concordia Polska, provide coverage across a range of crops and perils. The government regulates premiums, subsidies and coverage parameters to promote affordability and consistency.

The primary goal is to shield farmers from financial losses caused by adverse weather, whilst encouraging widespread participation and reducing dependence on emergency disaster aid. A secondary objective is to ensure vulnerable smaller farms can access basic insurance coverage.

The compulsory insurance program safeguards major crops including cereals, maize, rapeseed and fruit trees against primary hazards such as hail, spring frost, floods and drought. Livestock coverage extends to animals such as cattle, horses, and poultry from risks including flooding and forced slaughter. Farmers seeking broader protection can opt for voluntary insurance policies covering additional risks, such as landslides and pest outbreaks. These policies, often bundled with mandatory ones, benefit from government subsidies, making them appealing for comprehensive coverage.[200]

Insurance penetration is approximately 40% of UAA. However, uptake varies as large commercial farms tend to participate more, while smaller and subsistence farms remain underinsured due to financial constraints or insufficient confidence and awareness.[201]

200 Gov.pl. (2023, November 22). Dopłaty do ubezpieczeń rolnych w 2024.
201 Gob.pl. (n.d.), Agriculture Restructurisation and Modernisation Agency.

Since its inception in 2008, the system has strengthened farmers' financial resilience to climate-related risks, supported by government subsidies to enhance access. However, coverage remains uneven with smaller farms under-represented as many insurers lack agricultural specialisation, reducing their capability to deliver services.[202]

Despite considerable success, the system faces challenges. Rising claims from more frequent and severe weather events place growing financial pressure on both insurers and government budgets. Addressing these concerns is essential to ensure the system's durability and equitable access for all farmers.

Other public funds in Poland for disaster finance that are not part of the insurance system structure

Poland also has a disaster relief programme to address catastrophic losses not covered by insurance. This program provides compensation for damages to infrastructure, productive assets, and other long-term impacts on farming operations.

Poland is a major beneficiary of CAP funding, which supports agricultural risk management through subsidies for premiums and resilience-building investments. While Poland's agriculture insurance system has seen significant progress, addressing gaps in coverage for small farms, improving insurer expertise and ensuring financial sustainability will be key to its future success. The complementary use of CAP funds and disaster relief programmes provides a strong foundation.

Severe loss years

a. 2015

An **extreme drought** in **2015** impacted 70% of Poland's agricultural area. This event caused widespread yield reductions with cereals experiencing a 12% decline, vegetables dropped by 20%, and potatoes by 25%.[203]

The financial impact of the 2015 drought was significant, with related State assistance and farmer compensation exceeding PLN 752 million (some EUR 170 million) in subsequent years. [204]

b. 2020

Poland experienced one of its most severe droughts in the **spring of 2020** following consecutive dry years (2018 and 2019) and a warm winter. This caused drastic soil moisture deficits, particularly in central Poland, with crop losses reaching up to 50% for silage maize, 25% for potatoes and 20% for vegetables.[205]

Risk Based Assessment: current conditions and 2050

a. Protection gap and primary perils for extreme losses

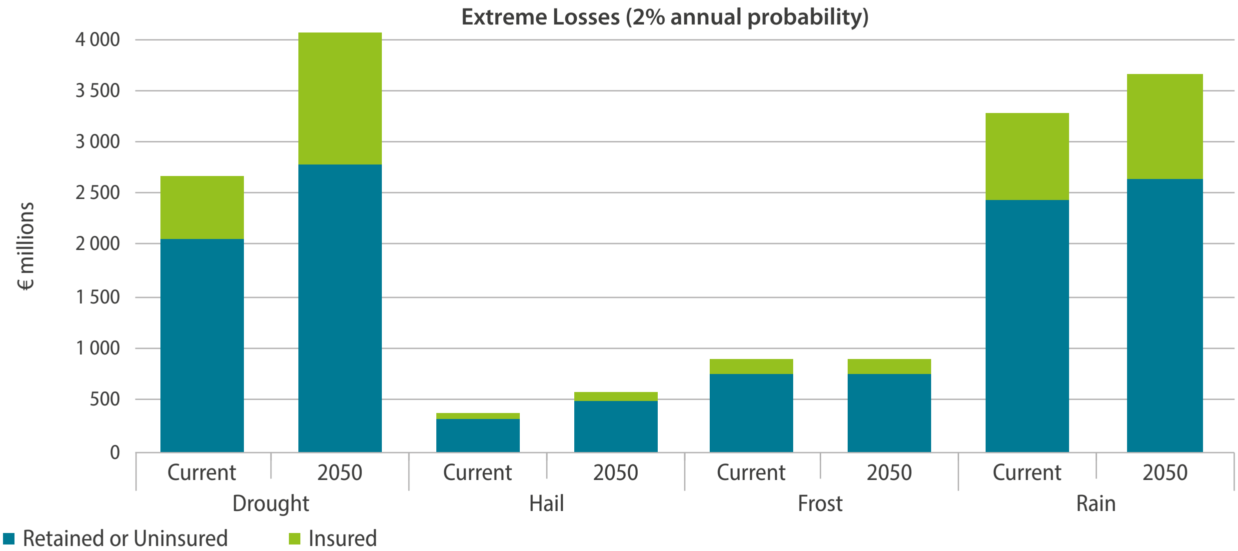
The current 1-in-50 PML from drought, hail, rain and frost is approximately EUR 4.1 billion. The moderate penetration rate of broad weather insurance in Poland results in a protection gap of 75-85% across these perils.

Excess rain is the primary peril for extreme loss years, with a 1-in-50-year PML of EUR 3.3 billion, projected to increase by approximately 12% up to 2050.

Although not the driving cause of extreme losses under current conditions, a 51% increase in drought losses would make it the primary peril for Poland by 2050 under the SSP5-8.5 scenario.

202 Ibid.
203 Ibid.
204 Pavlinec, A. (2024, June 6), Hail and drought – how severe will this year's agricultural damage be?
205 Alwis Uberzpieczenia (2024), Ubezpieczenie upraw rolnych w 2024 roku.

Figure 61: Risk layering for extreme (1-in-50 year) losses (2 % annual probability) – Poland.

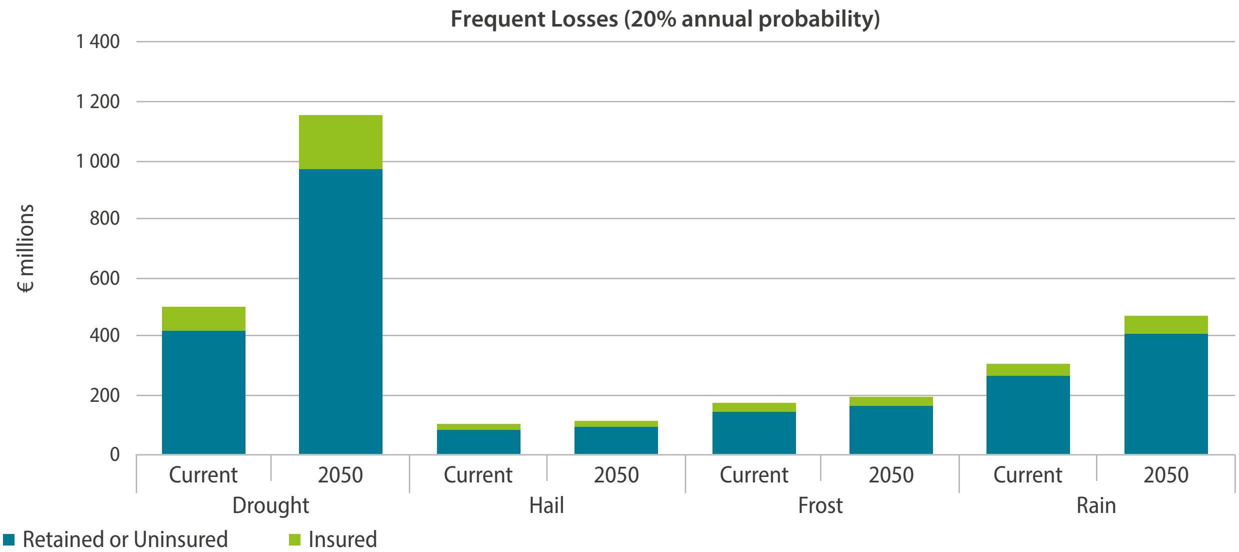


Source: Authors.

b. Protection gap and primary perils for frequent losses

Across the primary perils, an estimated 85% of frequent (1-in-5-year) losses are expected to be entirely uninsured or retained by farmers. Currently, the 1-in-5-year drought PML is approximately EUR 496 million, more than doubling by 2050 to EUR 1.1 billion. Larger frequent losses for farmers could undermine their ability to recover from bad years and may impact long term financial stability including access to credit and investment in farms.

Figure 62: Risk layering for frequent (1-in-5 year) losses (20 % annual probability) – Poland.



Source: Authors.

Romania

Key Reference Information

Agriculture as % of GDP	3.8% of GDP [206]
Agriculture % of national employment	23% of national workforce[207]
Agriculture as % of exports	11.3% of total export[208]
Major crops (share of overall agricultural output)	27% Cereals 16%Vegetables and horticultural products 9% Forage plants 8% Industrial crops 8% Fruit 7% Potatoes[209]
Primary climate perils	Drought, heatwaves, flooding, storms, landslides, wildfires

Insurance System Summary

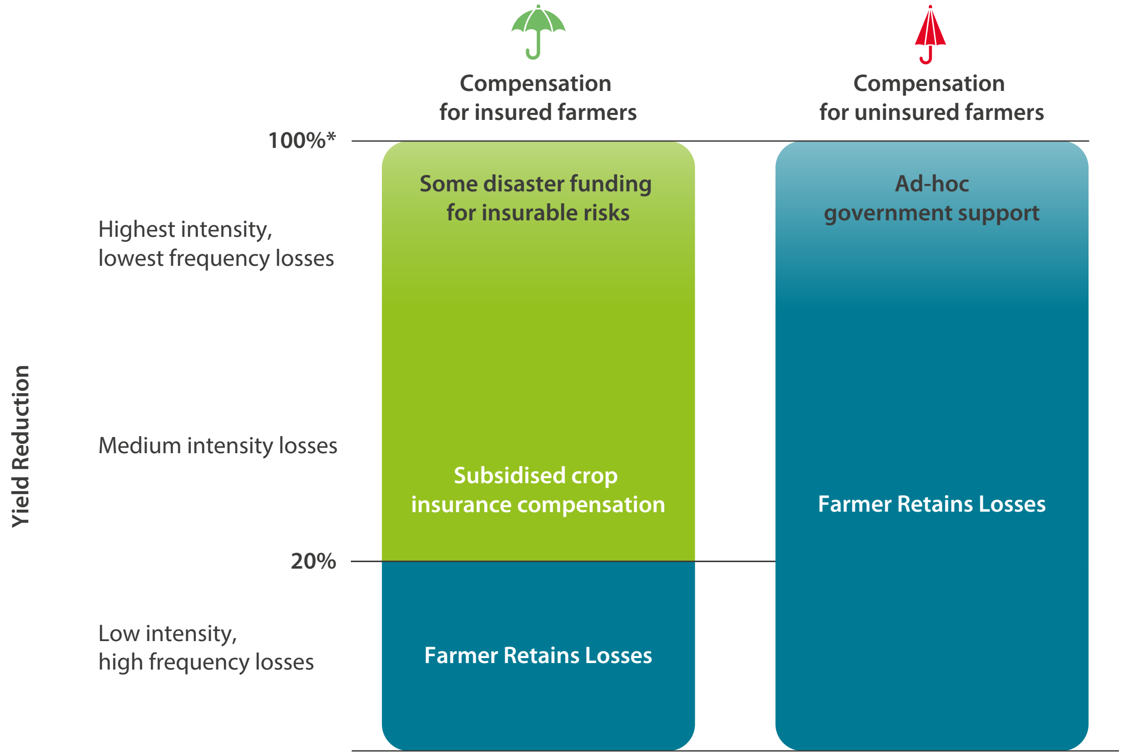
Perils insured	Hail, Drought, Floods, Frost, Storms
Crops insured	Maize, Sunflowers, Wheat, Specialty crops
Compulsory insurance (by crop or peril)	No
Overall Insurance penetration	30%
Average loss ratio	Unknown
Number of insurance companies	12
% of premium subsidised	Up to approximately 70%
Public sector risk pool within the insurance system	No

206 Stastica (2025b), Contribution of agriculture to gross domestic product in Romania from 2014 to 2021.
207 European Commission (2023f), Romania: CAP Strategic Plan 2023-27.
208 European Commission (2021h), Statistical Factsheet Romania.
209 Ibid.

Structure of the insurance system and observations to date

Insurance system structure

Figure 63: Schematic of Agricultural Insurance Layering in Romania.



Source: Authors.

Romania's agricultural insurance system has progressed with government support and innovative solutions such as index-based drought insurance.[210] Subsidies funded under CAP cover up to 70% of eligible premiums. These measures have facilitated broader adoption among medium and large-scale agricultural operations. Notably, Austrian Hail Insurance has emerged as a key player, capturing a significant market share with products such as parametric drought insurance, based on predefined indices, which streamline payouts. Plans to expand drought-specific coverage to 7 million hectares underscore a growing commitment to mitigating climate-related risks, which are increasingly frequent in the region.[211]

Agriculture insurance coverage remains limited, with only 30% of arable land insured and the agricultural sector representing a mere 0.8% of the national insurance portfolio.

210 Reuters (2024) Romanian government plans drought insurance scheme for farmers.
211 Ziarul Financier (2024). Veşti bune pentru fermierii români afectaţi de fenomene climatice nefavorabile: Guvernul aprobă patru măsuri pentru a-i ajuta pe fermierii afectaţi de secetă.

Other public funds in Romania for disaster finance that are not part of the insurance system structure

Romania relies on a combination of national disaster relief funds and EU resources to support farmers affected by extreme weather events. These funds are typically reactive and allocated on an ad hoc basis in response to significant losses from droughts, floods, or other disasters. However, this support is often limited by budgetary constraints and does not provide the consistency or reliability of a dedicated disaster relief fund.

Examples of severe loss years

a. 2022

The severe drought of 2022 caused over EUR 1 billion in agricultural losses. Approximately one million hectares of crops were severely affected, with non-irrigated fields suffering near-total losses. Wheat, maize and sunflower yields were particularly impacted with farmers reporting up to 90% production losses in the hardest-hit areas.[212]

Due to the limited insurance coverage, many farmers had no financial protection against the drought's devastating effects. In response, Romania received EUR 33.9 million from the European Union Solidarity Fund (EUSF) to support emergency relief and recovery efforts. These funds primarily covered infrastructure repairs, clean-up operations and immediate assistance for affected communities.[213]

Despite this financial aid, the protection gap was substantial with more than EUR 950 million (over 95%) of uninsured losses likely falling on farmers' balance sheets.

Risk Based Assessment: current conditions and 2050

a. Protection gap and primary perils for extreme losses

The current 1-in-50 PMLs from drought, hail, rain and frost are approximately EUR 8.7 billion. Across these primary perils, 75-100% of losses are expected to fall on farmers.

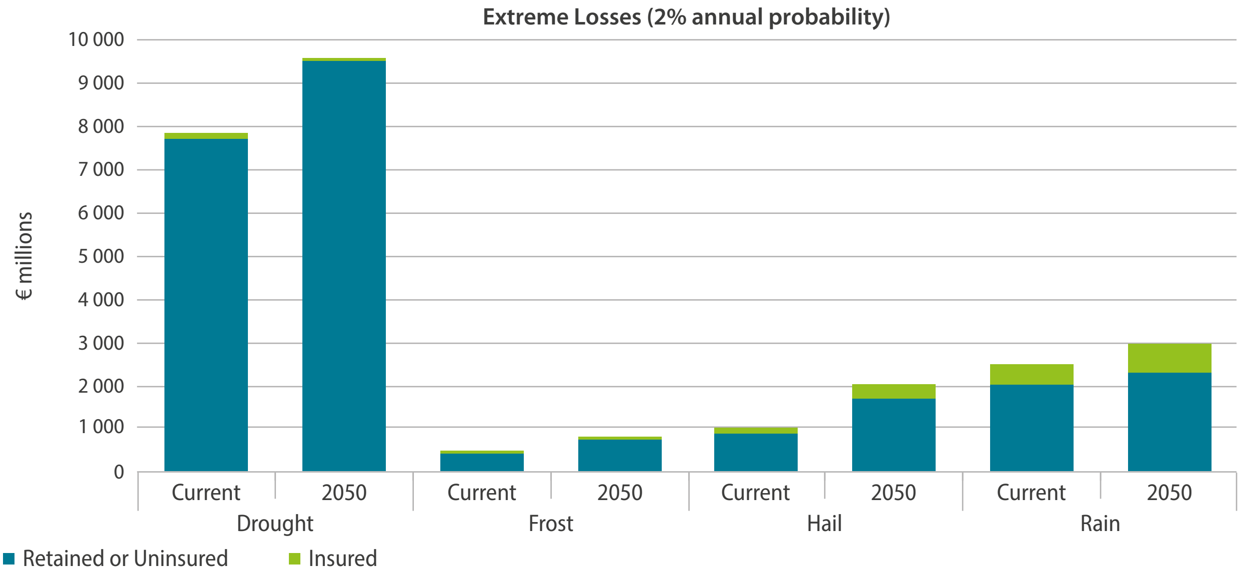
Drought PML alone reaches EUR 7.7 billion under the current climate increasing by 23% to EUR 9.6 billion under the SSP5-8.5 scenario.

The current 1-in-50 rain PML is some EUR 2.5 billion and expected to increase to EUR 2.9 billion by 2050. Coverage for this peril is more common, so under current insurance market conditions this would lead to an increase in the proportion of losses compensated by insurers.

212 Agroberichten Buitenland (2022) Drought wipes EUR 1 bln from Romanian agricultural sector.

213 European Commission (2023d) Almost EUR 34 million in European Solidarity Funds awarded to Romania to repair damages caused by severe drought in 2022.

Figure 64: Risk layering for extreme (1-in-50 year) losses (2 % annual probability) – Romania.

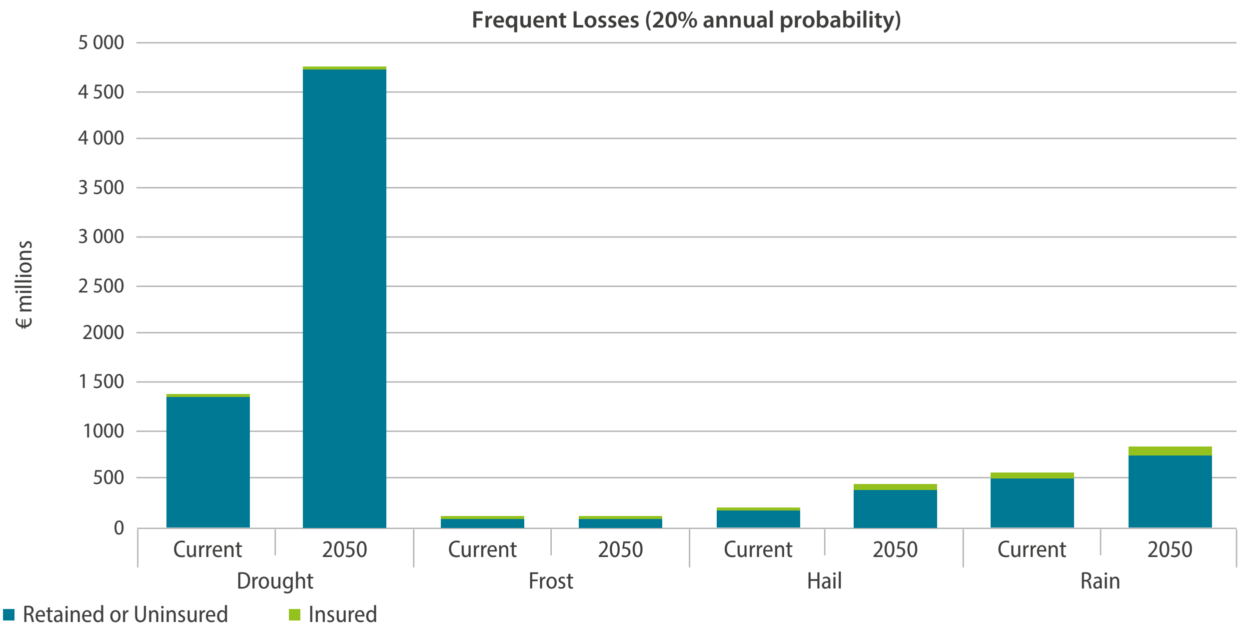


Source: Authors.

b. Protection gap and primary perils for frequent losses

Across the primary perils, 90-100% of 1-in-5-year losses are expected to be uninsured or retained by farmers. As in extreme losses, drought is the primary peril for frequent crop losses in Romania, falling mostly on farmers. Currently, 1-in-5 year estimated drought PML are about EUR 1.3 billion, but by 2050 these could threefold to EUR 4.75 billion. Larger frequent losses for farmers could undermine their ability to recover from bad years and may impact long term financial stability with knock on effects on access to credit and investment in farms.

Figure 65: Risk layering for frequent (1-in-5 year) losses (20 % annual probability) – Romania.



Source: Authors.

Part 4

Observations of EU agriculture insurance systems

PART 4.1: Observations of EU agriculture insurance systems

Observations on the structure

The European agricultural insurance market is characterised by major regional, technological, cultural and economic differences. Each country has created and developed its agricultural insurance market in distinct ways, adapting them in combined response to local circumstances and EU policies. The result is a diverse spectrum of insurance systems across the EU, with trends towards greater harmonisation. Member States such as Spain, Austria, France and Italy have well established agricultural insurance markets with government subsidies and private sector involvement. In other Member States, the market is still developing and the range of insurance solutions on offer is limited.

Efforts are being made to stimulate insurance market growth, increase demand, improve administrative processes and build risk management capacity among farmers. When national priorities align, many Member States support agricultural insurance with public funds and EU risk management tools available under the 2023-2029 CAP. These tools enable flexibility to adapt to the varied needs and risks faced by farmers in different regions while ensuring national programmes align with and are integrated into broader EU risk management strategies.

- EU agricultural insurance will play a growing role in fostering the sector's resilience, reducing the financial impact of climate risks and promoting sustainable agricultural practices. How national systems fulfil this role under CAP is the focus of this section, with observations from the findings of the Part 3.
- The CAP 2023–2029 framework includes expanded risk management support, but uptake remains limited. Historically, insurance-related expenditure accounted for less than 1% of the CAP budget, approximately EUR 2.5 billion in 2016, a stark contrast to the United States, where 60% of the Farm Bill budget is allocated to insurance.
- The revised CAP plan now offers subsidies covering up to 70% of insurance premiums for losses exceeding 20% of average yield. Despite these incentives, total insurance support remains around EUR 2.5 billion, with Italy (EUR 1.3 billion) and France (EUR 950 million) leading in utilisation.

Member State Support Mechanisms

There is significant variety in agricultural insurance support across Member States:

- Some countries, such as Denmark, Sweden and Ireland, provide little to no public support.
- Others, like Spain, have deeply integrated public support mechanisms, with EUR 3 billion in non-EU annual subsidies and a government-backed underwriting fund.
- Most countries offer some level of subsidy, through private or cooperative/mutual agricultural insurers. Denmark, Sweden Ireland, and Finland operate predominantly private, unsubsidised insurance markets, though these are relatively small.
- Greece, Cyprus, Poland, and Hungary have mandatory agricultural insurance subsidised by public funds.
- In general, higher insurance coverage correlates with significant public premium subsidies, though Sweden and Germany have long-established hail insurance markets that operate with minimal public intervention.

Agriculture Insurance Market Premiums

Total EU agriculture insurance market premiums (including subsidies) are estimated at about EUR 6 billion (2024), distributed as follows:

- France: ~EUR 900 million;
- Spain: ~EUR 1 billion;
- Italy: ~EUR 1.3 billion;
- Rest of the Europe: ~EUR 3 billion;

Observations from country risk assessments

The case study country systems in this report reflect the variety of public intervention, use of EU funds, crop and peril exposure across the EU. Countries with recent, notable changes include France and Italy who are looking to increase their insurance penetration, expand protection and align plans with new CAP Pillar II premium subsidy rules.

These changes include simpler multi-peril, multi crop programmes, with significant subsidies to increase affordability. These systems now have clear risk layering and incentives for farmers to use insurance, including lower ex-post disaster financing for uninsured farmers. Reforms have been designed to work with and through existing private insurance markets. It is too early to observe results and draw conclusions, and are distributed as follows:

EU risk modelling results show that drought risk dominates all sample countries and protection gap estimates indicate that most farmers are largely unprotected by insurance or prearranged public compensation schemes. In most countries, this is a result of low demand and a lack of product availability. Some Member States are outliers, such as Spain with its well-established system offering broad coverage.

Frost and hail are growing perils in central, eastern and northern European regions. Some Member States are better prepared than others, with Germany and Austria benefitting from well-established hail insurers and high rates of insurance penetration. Conversely, flood is a growing threat in these regions without the benefit of established protection.

Increases in the size of severe and catastrophic losses demand more claims payments from insurers, which will require responses in the costs, scope and availability of cover. In the same way, prearranged public financing schemes are likely to increase pressure on public funds.

Climate change will increase the frequency and magnitude of attritional losses, with more events falling below the standard 20% yield loss protection threshold. This could steadily and relentlessly drain farm finances with fewer good years of strong yields when reserves can be built. This highlights a significant challenge for financial protection instruments and the need to support farm adaptation and resilience.

Common Challenges Across the 10 Countries

Insurance penetration rates remain a significant challenge across the EU, with availability, affordability and administrative complexity being major barriers. In many countries, key perils such as drought remain uninsured, limiting farmers' ability to manage risks effectively. Even where insurance is available, its perceived value is often low due to high costs and uncertainty about claims processing and payouts.

Several systemic risks also persist. Adverse selection is a concern, as limited participation means those with the highest risks are more likely to seek coverage, leading to unsustainable insurance pools.

Unmanaged catastrophe exposure presents another challenge, as many Member States lack clear frameworks for handling extreme loss events without relying on unbudgeted emergency support from national governments or the EU.

Furthermore, the level of adaptation efforts to increasing climate risks remains uncertain and many systems lack long-term strategies to balance affordability and sustainability amid rising climate-driven losses. There is also minimal coordination between insurance mechanisms and broader climate adaptation incentives, reducing the effectiveness of risk management.

Approaches to address these challenges: insights from the 10 Case Studies

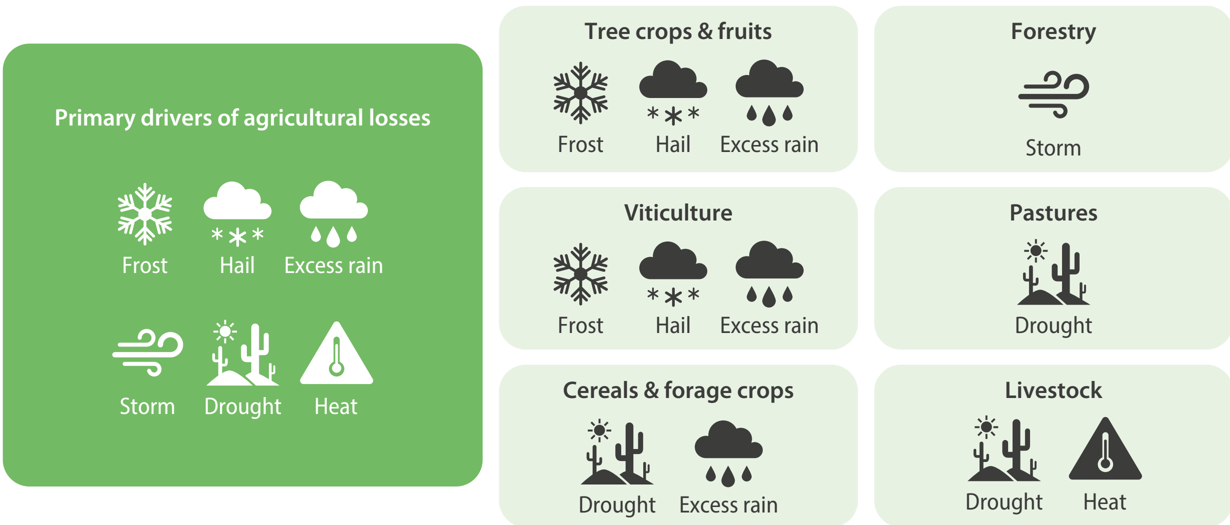
Several countries have innovative approaches to address these challenges. Spain and Austria have well-functioning national systems with relatively high insurance penetration and broad multi-peril coverage. Greece's mandatory system offers an example of how drought risk can be covered on a large scale. However, the sustainability of these systems in the face of increasing catastrophe exposure remains uncertain.

Other countries, including France, Italy and Poland have undertaken major reforms to increase insurance participation, expand protection and align with the CAP Pillar II subsidy framework. These reforms include simplified multi-peril insurance programmes with significant subsidies, clear risk layering to distribute costs between farmers, insurers, and governments as well as reduced disaster handouts for uninsured farmers to encourage participation. While these approaches show promise, concerns remain regarding rising attritional losses below the 20% yield loss threshold.

Additionally, while these new systems work alongside private insurers, it is unclear whether they provide strong incentives for innovation, such as advanced parametric insurance. Moreover, while the structural framework appears robust, the ability to manage a large-scale catastrophe remains untested. Given their recent implementation, the long-term impact of these reforms is still uncertain, but they could be a model for broader EU agricultural insurance harmonisation, allowing for local flexibility while ensuring more comprehensive risk coverage.

Observations on Crop Types and Insurance Implications

Figure 66: Primary perils by production type.



Source: Authors.

Fruit Trees (Apples, Plums, Apricots, Cherries)

Fruit trees are particularly impacted by hail, frost and excess rain, with losses unevenly distributed across the EU, as Member States tend to specialise in certain crops. For example, apple production is concentrated in Poland (34%), Italy (12%), Romania (12%) and France (8%). Peaches are mostly produced in Spain (41%), Italy (28%) and Greece (18%).[214]

In the last 5 years, heavy rain has impacted all main producers across Europe. Assessing future rainfall risks to fruit production is challenging given the lack of a unanimous climate change signal, with future rainfall trends varying depending on the climate model. Also conflicting studies mean rainfall effects in Europe need more detailed investigation.

Insurance data for fruit across the EU shows that coverage is generally lower than for cereals and viticulture. In many countries, there is no clear trend for insured area or value of fruit trees. In Poland, for example, the insured area of fruit trees fluctuated greatly, from some 10 000 hectares in 2014 to more than 42 000 hectares in 2018.[215] In Spain, for 2012 to 2023, the insured values of fruit crops ranged between almost EUR 1.3 billion in 2022 and EUR 2 billion in 2019[216], while in 2023 it was around EUR 1.4 billion. The insured values of apples in Italy also showed no clear trend in the last 10 years, fluctuating between EUR 577 million (2016) and EUR 761 million (2014).[217]

However, in Italy, the insured value of industrial tomatoes ('pomodoro da industria') more than doubled from EUR 275 million in 2018 to EUR 652 million in 2023. In Portugal, the insured value of all types of tomatoes under the Seguro de Colheitas (SC) crop insurance system increased from EUR 57 million in 2018 to EUR 95.7 million in 2022. In France, between 2016 and 2022, the insurance coverage for tree crops and fruit remained low, between 1.4% and 3.1%.[218] However, after the French crop insurance reform in 2023, coverage surged to 11% (see details in Part 3, France case study).

Claims and compensations in the fruit tree sector are mainly triggered by frost, hail and excess rainfall. Based on the analysis of FNGRA for claims in France, frost accounted for almost 70% of payouts for tree crops and fruit, similar to viticulture. Hail and excess rainfall cover smaller proportions of 14% and 10%, respectively. In Greece, annual average compensation (2006-2021) paid out by ELGA are also highest for frost (EUR 22.8 million) and hail (EUR 11 million).[219] Frost and hail are also the main threat to fruit such as apples, cherries, pears, plums and peaches in Portugal, triggering the most compensation from 1996 to 2021. For tomatoes, extreme rainfall and floods accounted for almost 60% of average annual compensation from ELGA.

Potatoes and Sugar Beet

Sugar beet is an important crop for the EU, with over three-quarters of combined production being focussed in Germany (29%), France (28%), Poland (15%) and the Netherlands (6%). These countries also lead on potato production.

Flooding and waterlogging have historically caused some of the most significant yield and quality losses, particularly in these countries. Drought is increasingly a concern in southern and central Europe, reducing the reliability of yields and straining water resources.

Potatoes and sugar beet have played a small role in the crop insurance systems of most European countries, although this is starting to change. In the Netherlands, for example, the insured area of potatoes increased by over 10% from 2015 to 2022. By 2022, 21% of the cultivated area for consumption potatoes was insured, covered by the broad weather insurance scheme.

214 Agricultural production - orchards - Statistics Explained Eurostat (2025). Agricultural production – orchards.
215 Data extracted from the Statistical Agricultural Yearbooks of the Central Statistical Office (GUS).
216 Ministry of Agriculture, Fisheries and Food. (2024). Análisis y Prospectiva: Serie Indicadores.
217 ISMEA - SicurAgro - Dati assicurativi.
218 Koenig, R., & Brunette, M. (2023). Subjective barriers and determinants to crop insurance adoption.
219 ΕΛΓΑ. (2023). Πληρωμές 2023.

For sugar beet, area-based coverage increased from 4.4% in 2015 to 12% in 2022.[220] This positive trend is also visible in Poland where the insured area doubled from 48 800 ha in 2011, to 97 700 ha in 2022.[221] Insights into insurance claims or other compensation per peril are severely limited for these crops.

Vegetables and Horticulture

Like fruit, vegetables are produced in a range of climates. For example, carrot cultivation is spread out across the EU, whereas onions are concentrated in the Netherlands, Spain, France and Germany. Greenhouses are often used for vegetable production in cooler regions such as the Netherlands, or in protected growing centres in Spain.

Insurance coverage for vegetables and horticulture has increased in recent years in most countries where data is published. In Spain, the insurance penetration rate for vegetables in protected growing centres increased from 12.3% in 2009 to 21.4% in 2023.

Several perils affect other vegetables and horticulture. For example, in Greece, the highest annual average compensation (2006 - 2021) for vegetables was for excess rainfall and flood followed by hail and frost.

Cereals

France, Germany, Poland and Romania make up 60% of cereal production in the EU. However, there are significant variations, with some Member States specialising on certain crops and varieties. For example, Italy accounts for over half of durum wheat and rice production in the EU, while Hungary produces nearly 20% of the EU's sorghum.

Cereal production is adversely impacted by drought and excess rainfall, both of which have been significant in the last decade. Climate models agree that droughts for most EU countries will become worse by 2050 across the various climate change scenarios. Some cereal crops will be affected more than others though maize shows adverse effects in nearly every country. Conversely, the north of Europe, including Ireland, the Baltics and parts of Scandinavia, Germany and Poland, could see benefits for barley and wheat production due to changes in precipitation.[222]

The insurance data shows an increase in coverage for cereal crops in recent years. In France, for example, the insurance uptake for cereal and forage crops increased by almost 10% between 2015 and 2023. In 2023, 35% of cultivated cereal and forage crops were insured under the MRC (L'assurance multirisque climatique sur récoltes) insurance scheme. In addition, more than 50% of insured crops in France were cereals and forage.[223] In Poland, the insured area of cereal crops increased by more than 800 000 hectares between 2016 and 2022.[224] Cereals account for more than half the insured crop area in the country.

More than 80% of cereal and forage crops in France were affected by droughts as well as flood and excess rainfall. Between 1990 and 2006, almost 60% of crop damage in Germany was due to drought. A recent analysis shows that the average annual losses due to drought in winter, for wheat alone, exceed 23 million.[225]

220 Tweede Kamer der Staten-Generaal (2024). Evaluation of the broad weather insurance scheme.
221 Statistical Office of Poland (GUS). (2023). Statistical Agricultural Yearbook 2023.
222 Joint Research Centre (2020), PESETA IV: Climate change impacts and adaptation in Europe.
223 Assemblée Nationale (2024), Rapport d'information n° 2700: Refonte du système assurantiel agricole.
224 Statistical Office of Poland (GUS). (2023). Statistical Agricultural Yearbook 2023.
225 Schmitt et al. (2022), Extreme weather events cause significant crop yield losses at the farm level in German agriculture - ScienceDirect.

Olives

Olive oil production is concentrated in Mediterranean regions, Spain (49%), Italy (27%), Greece (13%) and Portugal (10%), where around 99% of olive oil is produced. Olive trees are resilient to changes in climatic conditions, however they are susceptible to droughts and pests. In 2014, Spain suffered an outbreak of the 'olive fly' and, in 2022, the Italian olive sector saw a significant decline in production due to drought, high temperatures and the 'olive fly'. The result was a 37%, or 121 000 tonne, reduction in production.

Insurance uptake for olive trees is generally low in the EU, however, drought, hail and frost are the main factors resulting in claims and payments for olive harvests. In Spain, the largest olive oil producer in the world, it ranged between 6 and 10%.[226] In Italy, the insured value of olive crops increased from EUR 14.5 million in 2014 to more than EUR 35 million in 2023. Frost (EUR 34.9 million) and drought (EUR 8.9 million euros) were the main contributing factors to losses in the Italian olive sector in 2023.[227]

Wine Production

The EU is the world's largest wine producer. Over 78% of EU wine production is concentrated in three Member States, with 1/3 produced by France and Italy, and 1/5 by Spain, though the exact proportions vary each year depending on growing conditions. Germany, Portugal, Romania, Hungary, Greece and Austria also have significant wine production.

Hail, frost, pest and disease cause the worst impacts on production. The greatest hail risk is in large fruit growing areas (both grapes and fruit trees) such as southern France, north and eastern Spain and northern Italy. ESSL[228] and earlier the RAIN[229] project show expected trends for hail under various climate scenarios with increasing moderate (>2cm) and large (>5cm) hail for RCP4.5 and RCP8.5 scenarios. Although the risk has worsened, there is no clear trend for hail damage across the EU, possibly due to hail protection measures.

The number of frost days is expected to increase in some key wine growing regions, for example in eastern Spain and north-eastern France. In some coastal areas the number of frost days is expected to decrease significantly, for example in western France. In France, frost accounts for almost 70% of FNGRA viticulture payouts, while around 15% of claims are related to hail damage. In Spain, hail caused the most damage to grapes in 2023. [230] In Portugal, 63% of compensation paid under the SVC scheme between 2012 and 2022 was due to hail and more than 25% was due to frost.

Data shows an increased uptake of insurance in recent years. In France, between 2015 and 2023, 35% of cultivated wine grapes were insured under the multi-risk crop insurance schemes, demonstrating a 17% growth in uptake. In Italy, the insured value of wine grapes increased by more than EUR 700 million between 2014 (EUR 1.6 billion) and 2023 (EUR 2.3 billion).[231] In Spain, almost 50% of the cultivated area for wine grapes was insured in 2023, an increase of 17% from 2014.

226 Schmitt, J., Offermann, F., Söder, M., Frühauf, C., and Finger, R. (2022). Extreme weather events cause significant crop yield losses at the farm level in German agriculture.
227 ISMEA (n.d.), SicurAgro - Dati assicurativi.
228 European Severe Storms Laboratory (ESSL), (2024), The effects of severe storms in Europe.
229 RAIN Project (n.d.), Risk Analysis of Infrastructure Networks in Response to Extreme Weather.
230 Copernicus. (2023), Storm DANA hits Spain.
231 ISMEA (n.d.). SicurAgro - Dati assicurativi.

Pasture and grasslands

The insurance of pasture and grasslands against weather extremes is relatively nascent in the EU. Historically, insurance only existed for cash crops and not for grasslands and pastures because production fluctuations could not be measured consistently. However, satellite technologies have in recent years enabled reliable measurement of such production variations.

In France, a grassland insurance scheme was launched in 2015 as part of the MRC policy. The scheme is based on a grassland production index, verified by several protocols. Since the reform of the French crop insurance system in 2023, an insurance penetration rate of 9% has been registered. Drought is the main climate extreme responsible for insured losses, causing 95% of pasture and grassland losses covered by FNGRA.

PART 4.2: Examples of agricultural insurance systems in non-EU countries

Understanding the successes and limitations of agriculture insurance systems outside the EU can provide useful insights. While acknowledging that there are a number of significant differences, this section provides an overview of the insurance systems in the USA, Canada and India.

United States of America

System Classification and organisation

The USA has a public-private agriculture insurance market, with state support administered via the Federal Crop Insurance Corporation (FCIC). This is a wholly owned government corporation under the management of the US Department of Agriculture (USDA), which provides financial backing to the crop insurance market through the provision of premium subsidies, reimbursement of administrative and operating expenses, and public reinsurance of private insurers.

Subsidised insurance is provided through Approved Insurance Providers (AIPs), which are private insurers authorised to market and sell crop insurance to farmers. USDA's Risk Management Agency sets the rates and manages regulations. AIPs receive payments from USDA to subsidise the premiums paid by farmers. The rate of subsidy depends on the type and level of coverage. The FCIC also reimburses AIPs for administrative costs associated with selling and servicing crop insurance.

AIPs enter into Standard Reinsurance Agreements (SRAs) with the FCIC, which share risk between the private AIPs and the public reinsurer. Under the SRA, AIPs designate underwritten policies to one of two funds ('assigned risk' or 'commercial') with different levels of risk and profit retention. The designation of risks to these funds allows for AIPs to assume less risk for policies in areas deemed to be at higher risk, improving the amount of coverage for riskier areas. Under SRAs, in states with positive underwriting results, AIPs must share a portion of profits with the FCIC.

System Performance

Insurance is available for more than 130 major and specialty crops against a range of adverse weather conditions and diseases, with flexibility for farmers to customise policies to cover, for example, yield or revenue losses. Individual, yield-based policies are the most common in the US[232].

Since its inception in the 1930s, the Federal Crop Insurance Program has been key for agriculture in the United States. Today, the programme covers an average of 293 million acres annually, around 80% of eligible arable land.[233]

In addition to the programme, farmers can purchase crop-hail insurance offered privately by crop insurance companies. These products are not subsidised and cover only damage from hail, or other named perils such as fire or lightning.

Although there are year-to-year variations, drought is consistently a leading cause of indemnified losses. Since 2000, 44% of indemnity payments were for drought or high temperature losses. Excess moisture is also prominent, accounting for 26% of total indemnity payments since 2000.

Although claims have trended upward since the early 2000s, the overall actuarial performance of the programme has improved. Prior to the mid-1990s, loss ratios were often greater than 100%. Following major legislative and underwriting changes in the 1990s, loss ratios reduced considerably. However, volatility is still observable, necessitating continued management through the SARs.[234]

Premium subsidies represent the largest share of total programme costs, totalling USD 12 billion in 2022. Other costs for the PPP structure include financial agreements defined in the SRAs. Federal expenditure on premium subsidies through the FCIP has increased greatly, largely in line with insured insured area, as well as changes in crop exposure values and increased losses from extreme weather events.

The design of the US agriculture insurance system is central for risk management and income stabilisation for farmers, who receive less support than EU farmers through other means, such as direct payments.[235]

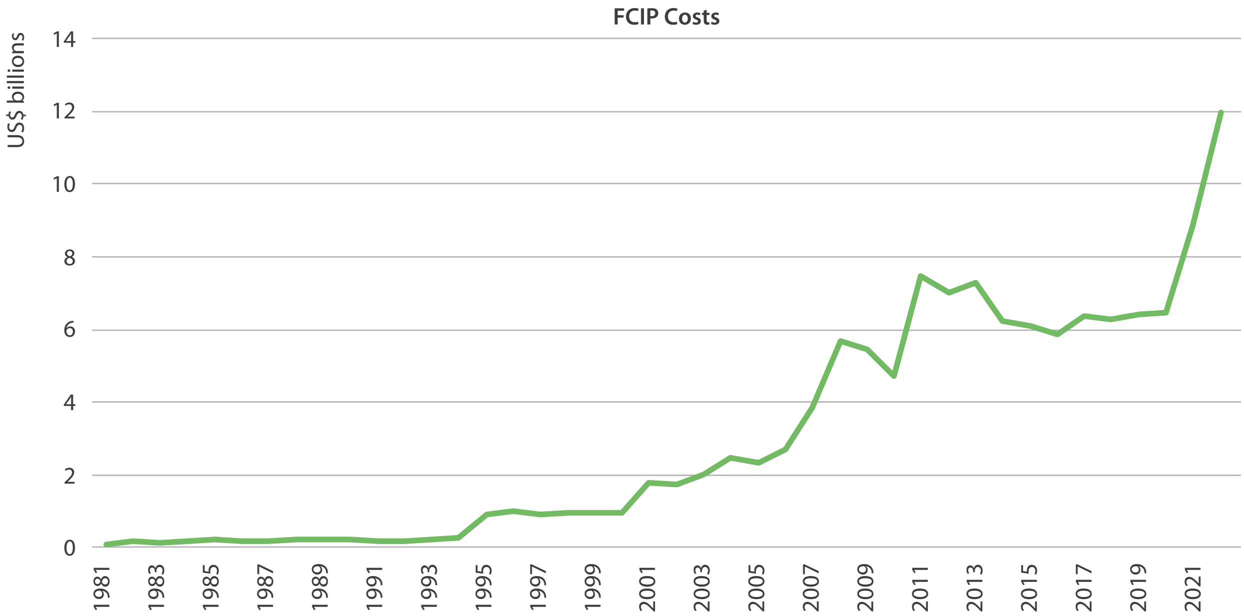
232 USDA Economic Research Service. (2025). Crop Insurance at a Glance.

233 Starting in 2016, insured acres rose rapidly, reaching 494 million acres for the 2022 crop year. Much of this rise was due to new policies for Pasture, Rangeland, and Forage. Forage represented 16% of insured acreage in 2016, rising to 48% by 2022.

234 USDA Economic Research Service. (2025). Crop Insurance at a Glance.

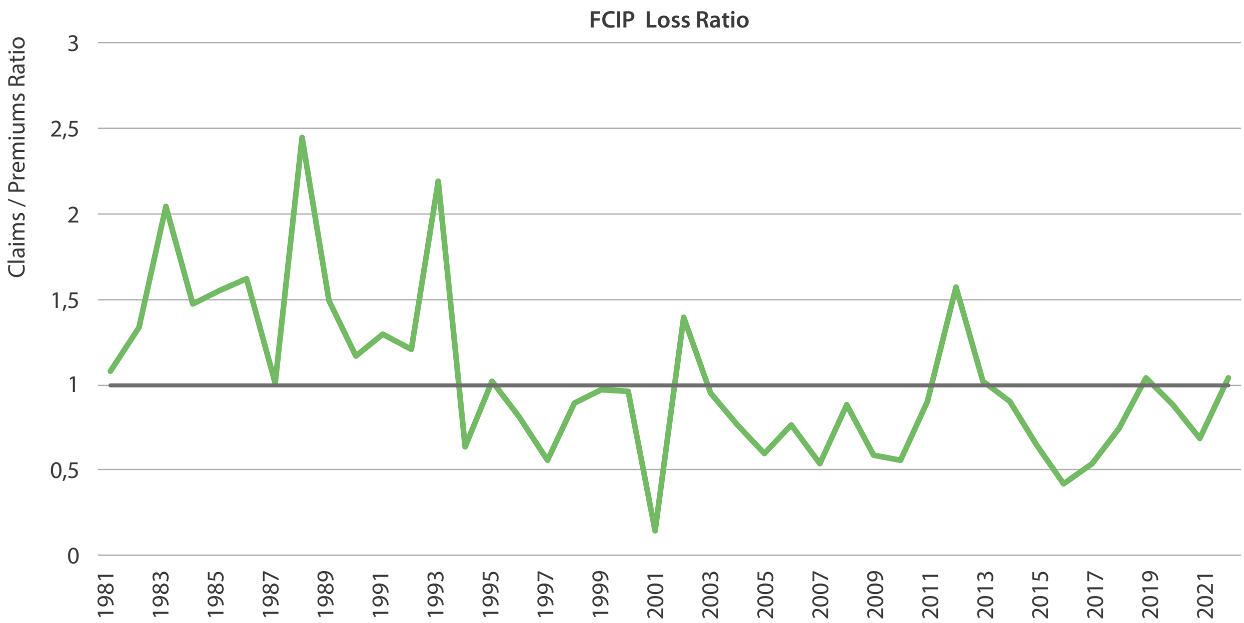
235 Direct payments to the farm sector averaged around 5% of gross cash income in 2022. USDA. (2022). How much do farmers receive in government farm program payments?. In the EU, direct payments made up 8-45% of farmer incomes for 2018-2022. https://agriculture.ec.europa.eu/data-and-analysis/financing/cap-expenditure_en.

Figure 67: FCIP cost in USD billions.



Source: USDA Economic Research Service. (2025).

Figure 68: FCIP Annual Loss ratio.[236]



Source: USDA Economic Research Service. (2025).

236 USDA Economic Research Service. (2025). Crop Insurance at a Glance.

Canada

System Classification and Organisation

Canada has a mostly public insurance system for agriculture, with funding split between federal and provincial levels. The AgriInsurance Program is a statutory contribution initiative under the Agriculture and Agri-Food Canada (AAFC) government department and is administered at the provincial level. It forms a core component of the Business Risk Management programmes, designed to help Canadian farmers address risks that threaten their businesses.

Under AgriInsurance, Crown corporations (government organisations) design and deliver multi-peril crop insurance which is subsidised by the federal and provincial governments up to 24% of the pure premium and 40% of the administrative costs.[237]

Provinces contribute a portion of premiums to the AAFC's Federal Crop Reinsurance Programme. This provides participating provinces with reinsurance in the event of large losses. Provinces contribute a portion of premiums collected and, in exchange, the federal government agrees to share abnormal losses, with provinces covering a higher proportion of smaller losses. Catastrophic losses are covered by a federal backstop fund, which absorbs losses exceeding the disaster layer.

Alongside reinsurance, premium subsidies, policy and strategic guidance, AAFC also provides data and analytics relating to weather and agriculture production to improve programme design.

AgriInsurance has historically been the largest Business Risk Management state support mechanism for agricultural producers. Others include AgriInvest, a ~CAD 3.1 billion programme that deposits funds directly into the savings accounts of producers and AgriRecovery, a ~CAD 916 million programme to providing recovery funds for extraordinary expenses following a natural disaster, In addition, AgriStability is an income stabilisation tool subsidising farm profit margins. There is also private, named peril crop insurance available, however this is not subsidised by the state and is small, with premiums ranging between CAD 300 and CAD 500 million annually.

System Performance

Coverage is increasing, with the number of growers insuring 80% of their crop yield increasing from 35% to 60% between 2014 and 2022.[238] Around 70% of production value of most major crops was insured in 2014-2022.

Recent years have seen high losses for provincial insurers, driven by higher grain and oilseed prices and climate related losses from drought and extreme weather.[239] This has eroded their reserves and is exacerbated by the fact that the Federal Crop Reinsurance Programme only pays out when provincial insurers' reserves are completely depleted. Provinces must first rely on their reserves to pay claims in years with underwriting losses. As yet, the Federal Crop Reinsurance Programme has not paid out.[240]

237 Rémi Villeneuve (2024) Climate Change: Challenges and Opportunities for Crop Insurance in Canada.
238 Producer.com (2023), Crop insurance costs explode.
239 Ibid.
240 Agriculture and Agri-Food Canada (2023), AgriInsurance Program.

India

System classification and organisation

The agricultural sector in India differs in many respects from the EU, with over 85% of farms classed as small holdings.[241] More than 45% of the workforce engage in agricultural and related work,[242] generating 15% of GDP[243] and making the agricultural sector is a political priority.

India operates a system with high levels of coverage, especially for index-based insurance, which relies heavily on public funds to unlock private markets. The insurance system is public-private and heavily subsidised by the central government through the Pradhan Mantri Fasal Bima Yojana (PMFBY).

India previously operated a public agriculture insurance system under the National Agricultural Insurance Scheme which was initially mandatory. High premium subsidies and a funding model based on post-disaster contributions meant that reliance on state funding was difficult to control. The reformed system still provides premium subsidies, often over 90%, but is voluntary and risks are underwritten by insurers rather than a centralised scheme. Under PMFBY, states enter into 3-year agreements with insurance companies to provide coverage. The largest crop insurers are all state owned.

The cost of premiums is shared between the central and state governments and farmers in a pre-defined ratio. There is no upper limit to subsidies, and farmers pay uniform premiums across entire regions, which has made crop insurance more accessible and affordable, providing a safety net that has increased the ability of farmers to invest in planting two crops per year, significantly improving the sector's agricultural output.[244]

The main insurance products are based on yield indices, which measure yield losses from crop cutting experiments over a representative insured area, and weather indexes, based on predefined weather triggers over a defined area. Reinsurance is not subsidised and is available on the private market. Underwriting data and the discipline of primary insurers are some concerns to the provision of agriculture insurance in India.[245]

System performance

The primary crops covered under the PMFBY are rice, wheat, soybeans, cotton, oilseeds and pulses. All non-preventable natural risks in the crop cycle, from pre-sowing to post harvest, are insurable via an area approach, with limited named perils insurable at plot level. Cover is available for yield losses, prevention from sowing, post-harvest losses and some local calamities on an individual farm basis.

Loss ratios fell below 100% for the first time in almost a decade after the introduction of PMFBY, but uptake is moderate, with 29% of farmers insured in 2023.[246] Data accuracy for crop losses and claims payment issues have been attributed to the variable insurance uptake among farmers. As a result, significant priority has been given to developments in this area, such as mandatory use of technology in claims settlement. This includes on-field uploads for crop cutting results, a claims portal and smart sampling using satellite data.[247]

241 Kumar, S., & Patel, R. (2022), Current status of small-holding farmers in India.
242 Indian Parliament. (2024). Agricultural policies and farmer subsidies in India. Lok Sabha Reports.
243 Economic Times. (2023). Share of agriculture in India's GDP declined to 15% in FY23: Govt.
244 Financial Protection Forum. (2023a). PMFBY Scheme.
245 RMS (2020), Crop Reinsurance in India.
246 Financial Protection Forum (2023b), Transforming Agricultural Insurance in India.
247 RMS (2020), Crop Reinsurance in India.

PART 4.3: Adaptation

Adaptation in agriculture is essential to reduce the growing risks posed by climate change and maintain a sustainable balance in the risk management layers. Adaptation covers strategic adjustments in agricultural systems to withstand and thrive under changing environmental conditions, while sustainability focuses on practices that preserve resources, protect ecosystems and ensure long-term productivity.[248] In the EU, these concepts are deeply intertwined, aiming to balance economic viability with environmental stewardship. The focus is on reducing immediate risks and fostering resilience for future climate challenges by integrating sustainable practices into policy frameworks and operational strategies.

In the EU, agriculture faces mounting challenges from climate risks, necessitating transformative shifts in production methods to balance environmental sustainability, economic viability and social equity. The EU's policies, notably CAP and the Green Deal, provide a strong framework to drive these changes. However, fragmented implementation, economic barriers and regional disparities threaten progress, requiring a comprehensive strategy tailored to regions.

Sustainable Production in View of Climate Change

The EU Green Deal sets ambitious targets for sustainable agricultural practices by 2030, including a 50% reduction in chemical pesticide use, transitioning 25% of farmland to organic farming and reducing nutrient losses by 50% to minimise soil fertility degradation. These targets underscore the importance of practices that promote environmental health while ensuring economic viability for farmers.[249]

Diversifying crops and livestock remains one of the most effective risk-reduction strategies. A variety of crops and livestock can stabilise farm incomes by reducing dependency on a single commodity, mitigating risks associated with market fluctuations and climate events.

Technological advances are transformative for agriculture. Precision farming tools, early warning systems and climate-resilient crops enhance efficiency, productivity and resilience. Furthermore, drip irrigation reduces wastage by delivering water directly to plant roots. This has become crucial in drought-prone southern Europe, helping farmers reduce their reliance on rain-fed agriculture.

Regenerative agriculture is also a cornerstone of sustainable production, focusing on soil health, water efficiency and biodiversity. Practices such as no-till farming reduce soil erosion by up to 90% and improve drought resilience with an average upfront cost of EUR 961 per hectare. They can lead to fuel savings and improved yields after three to five years, while crop rotation minimises pest outbreaks and sustains soil fertility.[250] Agroforestry, practiced extensively in Mediterranean and central European regions, integrates trees into farming systems improving carbon sequestration with diversified outputs such as timber and fruit. However, these benefits often materialise only after a transition period, during which farmers face financial uncertainty. This underscores the need for robust financial support, including from subsidies, carbon markets and PPPs.[251]

248 Stringer, L. Fraser, E. Harris, D. Lyon, C. Pereira, L, Ward, C. Simelton, E. (2020) Adaptation and development pathways for different types of farmers.

249 European Commission (n.d.) The common agricultural policy: 2023 – 27.

250 (PDF) Regenerative Agriculture and Soil Health: Enhancing Biodiversity through Sustainable Farming Practices. Kabenomuhangi, R. (2024). Regenerative agriculture and soil health: Enhancing biodiversity through sustainable farming practices.

251 Ibid.

Sustainable practices and their implementation under EU Schemes

CAP and the EU Green Deal are instrumental in guiding European agriculture toward sustainable practices. These frameworks offer eco-schemes and funding mechanisms to promote environmental stewardship, climate adaptation and economic resilience. However, their effectiveness varies based on the regional context, agricultural system and farmer capacity.

Sustainable practices supported by CAP eco-schemes demonstrate diverse approaches for farmers to address climate challenges, improve productivity and contribute to the EU's environmental goals. The following practices illustrate how CAP funding is applied in various regions:

a. Organic farming

Organic farming avoids synthetic fertilisers and pesticides and should cover 25% of agricultural land under EU Green Deal targets. France, Germany and the Netherlands have been at the forefront of this transition, supported by CAP incentives for conversion and maintenance. Farmers benefit from strong consumer demand for organic products and robust supply chains, making organic farming a viable economic choice. Conversion costs average EUR 200 to EUR 360 per hectare, with additional annual running costs of about EUR 300 per hectare. Organic farming contributes significantly to biodiversity conservation and soil health, aligning with broader EU climate objectives.[252]

b. Integrated Pest Management:

This reduces reliance on chemical pesticides by combining biological, cultural and mechanical pest control. In northern Europe, particularly in Germany and Denmark, farmers employ buffer strips and pest-resistant crops under the CAP's sustainable use initiatives. Such methods align with the Sustainable Use Directive and address EU Green Deal targets for a hazardous pesticide use reduction of 50% by 2030.[253] However, broader adoption across Europe is constrained by number of challenges including limited access to technical expertise and funding.[254]

c. Regenerative Agriculture:

Regenerative practices such as no-till farming and cover cropping are gaining traction in some regions where soil degradation and water scarcity are pressing concerns.[255] CAP supports eco-schemes and carbon credit programmes, enabling farmers to offset costs. For example, cover cropping costs EUR 144 per hectare but improves soil fertility and reduces input needs over time.[256] Implementation of these techniques has been piloted across the continent demonstrating enhanced carbon sequestration and reduced erosion.[257]

d. Agroforestry:

Agroforestry integrates trees and shrubs into farming systems improving soil quality, water retention and biodiversity. This has been especially impactful in Mediterranean regions in Greece and Italy, where mixed-use farming addresses both ecological and economic needs. CAP funding for agroforestry includes subsidies for tree planting and maintenance, with costs ranging from EUR 591 to EUR 1 277 per hectare. Farmers also benefit from diversified income streams, such as timber and fruit, enhancing the economic feasibility of this approach.

252 Institute for European Environmental Policy (2024). The costs and benefits of transitioning to sustainable agriculture in the EU.
253 European Commission (n.d.) Farm to Fork targets - Progress.
254 European Commission (2016) Cordis – Final Report Summary – C-IPM (Coordinated Integrated Pest Management in Europe).
255 Farreira et al., (2022) Soil degradation in the European Mediterranean region: Processes, status and consequences.
256 Institute for European Environmental Policy (2024). The costs and benefits of transitioning to sustainable agriculture in the EU.
257 Rewarding farmers for regenerative agriculture is 'critical for decarbonising the food sector' | Reuters Early, C (2024) Rewarding farmers for regenerative agriculture is 'critical for decarbonising the food sector'.

e. Water Management:

Addressing water scarcity, particularly in southern Europe, is a central focus of CAP's climate adaptation measures. Techniques such as drip irrigation and rainwater harvesting reduce water wastage and dependency on rain-fed agriculture. Drought-prone regions in Portugal and Spain can benefit from CAP support for irrigation infrastructure, which can cost between EUR 431 and EUR 2 500 per hectare but ensure stable yields during dry periods, improving resilience to climate variability.

f. Precision Agriculture:

In technologically advanced regions in Germany and the Netherlands, precision farming optimises input use through GPS-enabled equipment and remote sensing. These innovations are supported under CAP's resource efficiency programmes and significantly reduce fertiliser and pesticide use, directly contributing to Green Deal goals. Precision farming's high initial costs are offset by long-term savings and improved productivity, demonstrating its potential for broader application across Europe.

g. Biodiversity Conservation:

Biodiversity practices such as hedgerows, flowering strips and buffer zones are widely implemented across western Europe to address habitat degradation and species loss. France and Belgium have introduced habitat creation subsidies under CAP eco-schemes to encourage farmers to set aside non-productive land for pollinator-friendly habitats. These practices are crucial for maintaining ecological stability, particularly in regions near sensitive ecosystems. Farmers benefit from additional CAP funding, which offsets income lost from sparing land for biodiversity enhancement.

h. Carbon farming:

This focuses on increasing carbon sequestration in soil and vegetation through practices such as rewetting peatlands, conservation tillage and maintaining permanent grasslands. These techniques have been particularly effective in Germany and Ireland, where significant areas of farmland are used for carbon storage. Farmers can earn between EUR 10 to EUR 40 per ton of CO_2e sequestered, supported by CAP investments and voluntary carbon markets. These programmes contribute to EU climate goals and provide an additional revenue stream for farmers, enhancing economic sustainability.

There are financial and technical barriers when transitioning to sustainable farming. Upfront investments for biodiversity-enhancing features (EUR 591 to EUR 1 277 per hectare) or precision irrigation (EUR 431 to EUR 2 500 per hectare) can be prohibitively high, particularly for smaller farms. Additionally, a lack of standard metrics to evaluate the environmental and economic benefits of these practices further complicates their scaling. While regenerative farming promises long-term profitability with improved land value and reduced input costs, the initial transition period often involves yield reductions and increased labour, deterring widespread adoption.

CAP eco-schemes play a crucial role in offsetting these costs. Voluntary carbon markets reward farmers for sequestering carbon at EUR 10 to EUR 40 per tCO_2E, offering additional financial incentives. However, the fragmented implementation of eco-schemes and lack of a unified certification system for sustainable farming practices undermine their effectiveness.

Regional disparities are important when considering transitioning to sustainable practices. Economic conditions, institutional support and access to technology vary significantly across Member States, influencing the capacity of farmers to adopt new methods. These differences highlight the need to carefully consider local contexts in policy design and implementation.

Support through investments and more sustainable practices

Various EU funding sources already support adaptation, with CAP being the main tool to promote adaptation in agriculture. However, the current level of investment in adaptation is insufficient. Grant schemes and financing for adaptation in agriculture are very fragmented, with diverse ambitions at national and regional levels.

Support for adaptation would be enhanced by more collaboration between public authorities, financial institutions and (re)insurance providers, as well as agriculture stakeholders.

The role of insurance companies in promoting more adaptation and resilience should be further investigated. The insurance industry 'is uniquely positioned to support and reward investments in adaptation and resilience'.[258] Insurance companies can prioritise resilience in their near-term plans and define a resilience strategy, sharing risk data and information to improve public and private adaptation, creating partnerships with public authorities and advocating for consistent public policies to promote adaptation.

Austrian Hail Insurance – Incentives for climate change adaptation

The Austrian Hail Insurance is a not for profit mutual, with a large market share in Austria, but it is also operating in six neighbouring countries. The company operates beyond hail insurance and offers a full range of agricultural insurances.

In a public-private partnership Austria aims at providing comprehensive risk coverage through insurances instead of compensation of losses from public funds. For this purpose farmers receive premium subsidies covering approximately 55% of costs. This subsidy is funded through a combination of the Federal disaster fund, which is financed by an earmarked share of income taxes and the budget of the regions (Länder). The subsidies are channelled through all insurance companies active in the agricultural sector. This approach ensures that a wide range of crops, farming practices and livestock are protected, leading to a large market with a high participation rate and cover provided for approximately 80% of Austria's cultivated land. In 2023, EUR 234 million in premiums were underwritten.

The Austrian Hail Insurance offers a drought insurance, for example, that is based on a local weather index. It is based on two parameters - heat and lack of precipitation. The higher the local heat stress and the lower local precipitation is compared to the 10-year average the higher is the compensation the farmer receives. The insurance is available for crops, grassland and vineyards. After a drought event, the farmer requests compensation, which is automatically calculated on the base of local weather data using the amount insured and the precipitation deficit. The farmer does not need to document actual losses, making the payout and restitution quicker.

The Austrian Hail Insurance also offers innovative incentives for adaptation measures for wine cultivation. An investment in hail netting, which prevents the damage from hail to plants, is rewarded with an 80% reduction in the insurance premium linked to this. In case an insurance contract is signed for a minimum ten year period the farmer also receives an investment grant of EUR 1 500 per hectare. This grant covers about 25% of the cost of constructing hail netting and it is financed from Austrian Hail Insurance's own resources.

258 Oliver Wyman (2023). Building a Climate Resilient Future: five priorities for the global insurance industry.

In addition to the premium reduction and subsidy, the farmer can receive an additional investment subsidy from the Region. In case of the Styria region, for example, this can amount to another 30% of the investment cost, with young or organic farmers receiving an additional 5%.

For adaptation measures in fruit cultivation the company offers a premium reduction of 30% for stationary frost prevention measures, for example with sprinklers protecting the blossoms of the fruit trees. Also, the use of mobile frost prevention measures - like ovens and torches - can receive a premium reduction of up to 20%. Both measures can also receive a public investment subsidy of up to 30% from the Region (35% for young and organic farmers).

Source: Information provided by Austrian Hail Insurance.

PART 4.4: Climate risks and access to finance in the agriculture sector

Management of physical and transition risks in agriculture credit portfolios

Managing these risks is a significant challenge for financial institutions, especially as their agricultural loan portfolios are particularly exposed to these risks.

Physical risks such as heatwaves, wildfires, droughts, flooding and storms threaten agricultural assets, infrastructure and production capacity. These risks, alongside environmental factors such as soil degradation, deforestation and biodiversity loss, infer diminished collateral values and decreased revenue, increasing uncertainty for financial institutions.

Simultaneously, transition risks arising from regulatory changes, shifting consumer preferences and evolving sustainability standards are reshaping the economic circumstances for agricultural enterprises. As the sector accounts for approximately one-third of global greenhouse gas emissions[259], pressure to transition to low-carbon operations is increasing, further complicating lending decisions.

Financial institutions may respond to this risk by tightening credit offerings to the agricultural sector, particularly for businesses deemed highly vulnerable to climate shocks. Stricter lending criteria, higher collateral requirements and increased risk premiums may become more common in the medium term, particularly for smaller farms and businesses that lack the financial resilience to absorb climate-induced shocks.

As part of wider reforms to financial regulations, banks and other financial intermediaries must disclose their current and future exposure to physical climate risks in their loan books and investment portfolios. This might require banks to manage their exposure to farmers by tightening credit conditions and reducing capital allocations to higher risk agricultural areas.

According to a survey conducted jointly by the European Central Bank (ECB) and the European Banking Authority, financial institutions broadly acknowledge the materiality of physical and transition risks, though few have fully incorporated climate-related and environmental risks in their risk management framework. The ECB sees that institutions are increasingly involved in joint industry initiatives aimed at developing adequate methodologies and obtaining the necessary data.[260]

259 Tandon, A (2021) Food systems responsible for 'one third' of human caused emissions.
260 European Central Bank (2022) Walking the talk: Banks gearing up to manage risks from climate change and environmental degradation.

These expected adjustments in the credit industry and regulatory environment may lead to a vicious cycle with enterprises most in need of adaptation financing struggling to secure it, increasing their vulnerability to future climate risks.

There is no clarity on whether this is already impacting access to finance in the agriculture sector. fi-compass studies have estimated a financing gap of about EUR 62 billion for the farming sector in 2023, up from around EUR 46 billion in 2018.[261] There is no estimate on how much of this gap may be linked to the above-mentioned risk considerations. However, there is consensus that climate risks could reduce credit supply for the agricultural sector, in the medium to long term. Any EU agriculture risk management policy should ensure continued credit supply to the sector. Appropriate risk models and metrics should be developed to enable transparent risk assessment, whilst avoiding a potential 'credit drought'. Use of public financial instruments, such as guarantees, to cover these additional risks should also be considered.

Adapting credit to cater for climate risks

In addition to improving climate risk governance, some financial institutions believe they need to innovate their product offering for agricultural clients.

A recent survey of 167 financial institutions serving the agriculture sector in North America, Europe and India, indicated that 87% of respondents expect climate change to pose a material risk to their business.[262] In addition to improving their climate risk governance and risk management metrics, financial institutions believe they need to provide tailored advice and technical support for their clients, as well as innovative financial products that respond better to the developing risks.

'*Offering products to match the changing financial needs of agriculture clients due to climate change can enable clients to better manage climate change impacts, improve the risk profile of agriculture portfolios, and potentially boost revenue from offering new products to meet a growing demand*'. [263]

Despite evident risks, climate change also presents new opportunities for financial institutions. These include weather-specific financial products, increased credit for adaptation investment, services to facilitate the transition to climate-smart practices, carbon markets and increased funding from investors and government entities.

261 fi-Compass. (2023b). Financing gap in the agriculture and agri-food sectors in the EU.
262 Environmental Defence Fund, Deloitte (2022) The Impacts of Climate Change on Agricultural Finance.
263 Ibid.

Integrating climate risks into funding for agricultural projects, France[264]

Credit Agricole has developed a comprehensive package for farmers, including advisory support, flexibility in repayments for investment loans, as well as products to support short- and medium-term liquidity if the enterprise is affected by climate-related events or other emergencies.

To maintain cash flow, the bank suggests mobilising savings, offering a Precautionary Savings Plan. Additionally, farmers can activate hazard options on existing loans, including pausing repayments or adjusting instalments, decreasing these by up to 50% and extending the loan by up to five years.

For medium-term financial needs, Crédit Agricole offers solutions backed by a European Investment Fund guarantee. To address short-term requirements, the bank provides amortising loans to cover losses.

1 Mobilising savings
Including the Precautionary Savings Plan (DEP)

2 Acting on outstanding loans
Activate the hazard options of our "direct loans":
- pause
- modulation of maturities (-30% or -50%) maximum loan extension (+3 yr or +5 yr)

3 Financing the need in the medium term
Medium-term financing with "FEI" guarantee

4 Financing short-term needs
Short-term amortising loss

A number of private and public financial institutions are already adapting traditional lending to reflect increased risks from extreme weather events. Financial institutions recognise the necessity of crisis management instruments such as emergency liquidity lines and preferential loans for crisis response and risk prevention. In times of crisis, such financial instruments offer immediate relief by ensuring quick access to liquidity and working capital, enabling businesses to maintain operational continuity and recover quickly from adverse events. They complement agricultural insurance by covering broader financial needs, such as restoring production assets, replanting crops and stabilising cash flow in the aftermath of climate-induced financial pressures or economic downturns.

Furthermore, traditional investment loans for agricultural improvements are now being supplemented by more flexible products, acknowledging the unpredictable nature of climate risks. By allowing borrowers to adjust instalments, extend loan duration or temporarily suspend payments, flexible financing ensures that businesses can maintain liquidity and sustain operations without the immediate pressure of fixed repayments. These instruments also encourage proactive investment in preventive infrastructure and encourage sustainable and climate-smart agricultural practices.

While these are interesting models, such products are not extensively used. Some financial institutions raise the issue of provisioning and capital allocation when flexible products are triggered by adverse conditions. Further analysis, as well as knowledge transfer and awareness raising for financial institutions and sector stakeholders, may be beneficial. The role of public financial instruments to promote product innovation in this area should also be further explored.

264 Presentation at the 10th EAFRD fi-compass annual conference, Madrid 2024.

Auvergne Rhône-Alpes FEADER, France[265]

The Auvergne Rhône-Alpes FEADER Guarantee addresses critical financing needs for farmers, agro-industrial enterprises and forestry businesses facing risks related to climate change, environmental sustainability and unexpected climate hazards.

The financial instrument provides a first loss portfolio guarantee that supports new debt financing for farmers, agro-industry and forestry businesses with favourable loan conditions. The guarantee covers up to 80% of individual loans in a portfolio, with a portfolio cap of 10%, allowing for flexibility based on risk appetite and market conditions. By assuming part of the risk, this guarantee enables accessible lending conditions for farmers and rural enterprises in high-risk environments.

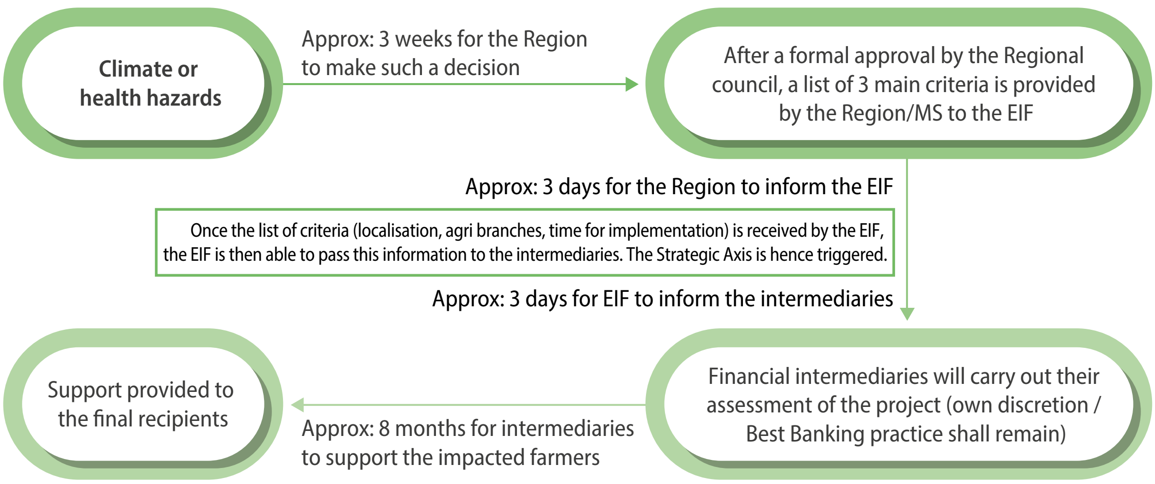
The Region appointed the European Investment Fund to manage a holding fund ('Participation Fund'), with five financial institutions (Banque Populaire Auvergne-Rhône-Alpes, Caisse d'Épargne Rhône-Alpes, Crédit Agricole, Crédit Mutuel and CIC) following an open call.

The instrument supports agricultural investments that encourage generational transition, competitiveness, climate-resilient practices, efficient water management and renewable energy use, helping farmers mitigate environmental risks and reduce their carbon footprint.

This instrument surpasses typical initiatives focused on competitiveness by integrating environmental sustainability and climate adaptation into its objectives. While traditional competitiveness measures often focus on productivity or market positioning, this instrument addresses broader structural challenges. It incentivises farmers to adopt innovative technology, as well as sustainable and climate-resilient practices, ensuring their long-term sustainability.

The instrument provides tailored crisis response with timely financial assistance to farmers impacted by climate or health-related crises. This ensures farmers can quickly stabilise their operations after a disruptive event.

By providing financial assistance for farms, especially for young farmers, and facilitating a transition to agro-ecological and organic practices, the instrument also reinforces sustainable agriculture with improved biodiversity, soil health, and climate resilience.



265 European Investment Fund (2023). Auvergne Rhône-Alpes FEADER.

Disaster Loan, Poland[266]

The Polish Disaster Loan Programme, managed by the Agency for Restructuring and Modernisation of Agriculture (ARMA), is critical to supporting farmers and agricultural enterprises after adverse weather events. The programme has evolved to address the increasing frequency and intensity of climate-related challenges, offering preferential loans through several credit lines including:

Credit line K01: A disaster investment loan for small and medium-sized enterprises (SMEs), primarily aimed at replacing fixed assets damaged by adverse weather.

Credit line K02: A disaster working capital loan for SMEs, to cover the immediate material costs of resuming production post-damage.

These instruments provide essential financial support for Poland's agricultural sector, particularly SMEs that suffer damage from adverse weather, enabling them to resume and stabilise operations.

The programme strengthens the resilience of Poland's agricultural sector by providing targeted financial support to farmers, enabling them to replace damaged fixed assets and secure working capital swiftly after disaster strikes, ensuring timely recovery and operational continuity.

The programme is a cornerstone of Poland's agricultural crisis management framework, providing disaster loans within 12 months of an official damage assessment. This timely financial support minimises the long-term economic impact of disasters on the agricultural sector.

Preferential loans under these credit lines are highly attractive for farmers as ARMA covers a portion of the interest owed, making loans more affordable.

ARMA coordinates the programme in collaboration with participating commercial banks. The decision to grant preferential loans lies with the participating commercial banks which independently assess a farmer's eligibility based on submitted documents and a thorough and efficient appraisal process.

266 Gob.pl. (n.d.) Agriculture Restructurisation and Modernisation Agency.

ICO-MAPA-SAECA credit and guarantee lines, Spain[267]

The ICO-MAPA-SAECA credit and guarantee lines were launched in March 2022 to alleviate severe financial difficulties in Spain's agricultural and fishing sectors.

The credit and guarantee lines were part of a range of responses initiated by the State to challenges caused by extreme weather, market disruptions and rising costs. They strengthen the resilience of agricultural and fishing operations, ensuring the continuity of their activities during crises.

The instrument offered loans up to EUR 100 000, supplemented by non-refundable subsidies covering up to 15% of a loan and the costs of the guarantee, capped at EUR 15 000 per client. Complementary regional support included additional interest rate subsidies in certain regions.

The instrument is jointly managed by the Ministerio de Agricultura, Pesca y Alimentación together with Sociedad Anónima Estatal de Caución Agraria and Instituto de Crédito Oficial as collaborating entities along with thirty financial institutions providing the underlying loans.

The state-backed subsidies for loans and guarantees enable more affordable credit to cover essential working capital needs for farmers and strengthen their capacity to recover and rebuild operations.

The instrument combines public funds with private sector collaboration, ensuring widespread access to finance for vulnerable subsectors and regions.

The additional regional interest rate subsidies complement national measures and highlight a collaborative effort to enhance the instrument's effectiveness at multiple governance levels.

Liquidity Protection Programme, Germany[268]

The Liquidity Protection Programme in Germany, initiated by Rentenbank under the Federal Ministry of Food and Agriculture, is an important support mechanism for agricultural SMEs facing economic instability.

It addresses risks from extreme weather events, animal diseases and market volatility and has evolved to address the growing challenges of climate change and market disruptions.

It provides low-interest loans to farmers experiencing at least a 30% drop in sales or earnings due to extreme weather events, or who can directly link their liquidity needs to the war in Ukraine.

Rentenbank, as the central refinancing institution, collaborates with cooperative, savings and commercial banks to offer loans under favourable conditions, helping farmers bridge financial gaps and sustain operations during a crisis.

267 ICO SGR/SAECA Guarantee - ICO_EN Instituto de Crédito Oficial (n.d.).
268 Rentenbank (2023), Rentenbank: Strong promotional activity in 2022.

The programme is flexible and adaptable, activated in response to diverse crises such as droughts, floods, the COVID-19 pandemic, and more recently the Ukraine conflict, ensuring timely and targeted support in changing circumstances. It ensures affordable financing through favourable fixed interest rates, capped risk-based premiums tailored to a borrower's creditworthiness and grace periods.

The programme's design features **state-backed response** provided by Rentenbank as a central refinancing institution and supported by **state-level development banks** and partnerships with **cooperative, savings and commercial banks** to deliver loans to eligible borrowers.

While the primary aim is to address short-term liquidity needs and support farmers in managing immediate crises, the programme also plays a proactive role in long-term risk prevention by enabling investments that enhance resilience against future challenges.

Finanziamento Scelgo Io Agricoltura, Italy[269]

'*I choose agriculture financing*' is offered by Crédit Agricole Cariparma in Italy as a flexible medium to long-term loan designed for agricultural individuals and businesses who require funding for investment or liquidity. The loan ranges from EUR 30 000 to EUR 300 000 for 18 to 60 months, with monthly repayments at either a fixed or variable interest rate. Collateral may be required.

A distinctive feature of this loan is the post-issuance flexibility which allows borrowers to adjust their repayments based on business conditions. After six months, they can increase or decrease their instalments by up to 30%, provided the loan duration remains at least 18 months and does not extend more than 24 months beyond the original term. Additionally, borrowers may request a suspension of repayments for a maximum cumulative period of 12 months in response to adverse economic or market conditions. The total loan term can be extended by up to 36 months through these options.

Borrowers can repay the loan in full at any time without additional fees. The loan can also be combined with government financial support, offering businesses further assistance. These features enable agricultural enterprises to adjust repayments in line with production cycles, seasonal variations and economic fluctuations, ensuring greater financial stability and adaptability.

269 Finanziamento flessibile Scelgo Io Agricoltura - Crédit Agricole Crédit Agricole (n.d.) Scelgo lo Agricoltura – Il finanziamento agrario con il massimo della flessibilià.

Part 5 Recommendations

PART 5.1: Guiding principles and rationale

Principles across all recommendations

This analysis has highlighted that the EU is largely unprepared for current, foreseeable losses from weather and climate risks. Approximately 20-30% of EU yield related losses are covered by insurance or prearranged contingency finance, and much less in some highly exposed countries. The remainder is borne mainly by farmers and the public sector through ad hoc disaster payments or indirect expenditure.

Despite these challenges, much can be done to reduce, manage and share climate risks for farmers, support investment and bring long term confidence to rural economies across the EU.

The following recommendations outline complimentary policy actions at local, national and EU levels. The recommendations are based on eight core principles:

- **Science and Insurance-aligned Risk Modelling**. The recommendations acknowledge the fundamental importance and dependence on insurance-aligned risk modelling and metrics, as applied in this report. After 30 years of adoption by the (re)insurance sector, wider risk capital markets and their regulators as well as supervisors in the EU and beyond, these methodologies provide a proven, practical and consistent basis for:
  - policy making on adaptation and risk transfer priorities and;
  - operational decision making and implementation.
- **Risk Layering**. The recommendations follow the risk layering framework of attritional, major and catastrophic losses applied throughout the report. This framework is used to design sustainable risk sharing systems and insurance-based risk management, and should be adopted to guide complementary adaptation and resilience interventions.
- **Subsidiarity and Market Evolution**. An overall principle for these recommendations is to work with and support existing national systems, insurance markets and EU institutions.
- **Public Private Risk Sharing and Blended Insurance**. All insurance systems, including EU agricultural markets, are a product of public policy and regulation. The combination of personal, public, private and mutual capital is a feature of robust and efficient natural disaster insurance systems around the world, including in several EU Member States. This hard-won experience should be used to optimise protection for EU farmers and creditors while balancing the share of risks taken by (re)insurers, Member States and EU institutions.
- **Risk-based Insurance Systems, Access and Affordability**. Sustainable insurance systems should be based on optimal understanding and evaluation of current and future risks, to ensure security and solvency in the short and long term. The golden rule is that insurance policy pricing should be risk-based, and that the income is sufficient to meets the liabilities of insurers. Most agricultural insurance systems worldwide rely on some form of discount via subsidies to make insurance accessible, affordable and attractive for farmers to support greater take-up and more widespread protection. Discounts and subsidies should be transparent, accountable and sustainable, based on clear costs and benefits at local, national and EU levels.

- **De-Risking through Climate Adaptation and Resilience**. Most climate hazards to EU crops and livestock will increase steeply and relentlessly out to 2050 even under the most optimistic emissions scenarios. Insurance alone cannot manage these risks, and so climate vulnerabilities to crops must be reduced through adaptation and interventions at farm, local and regional levels. These reforms and innovations require upfront investment including hail nets, irrigation, resilient crop varieties, early warning systems, changes in some cultivation areas and the implementation of regenerative agriculture techniques.
- **Insurance as Risk Governance for Agricultural Credit and Adaptation Investments**. Financially sustainable, science informed, and risk-based insurance systems can become the compass for agriculture risk governance, adaptation investment and disaster financing from local to EU levels. Ongoing insurability within reasonable parameters may become the reference for viable crop production, adaptation interventions, agriculture credit risks and investment across the EU.
- **Alignment with EU Climate and Finance Policies and Initiatives.** This report has coincided with complimentary recommendations on disaster risk financing and the climate protection gap from other EU institutions, including the ECB and EIOPA, as well as the Climate Resilience Dialogue co-chaired by DG CLIMA and DG FISMA. Climate risks to EU agriculture have also been highlighted by the European Systemic Risk Board and the European Stability Mechanism.[270]

The following recommendations illustrate examples of how these overarching principles can be implemented in the agricultural sector.

Recommendation summary: Laying the foundations for coherent EU agriculture risk management

While this study demonstrates a clear need to reinforce the EU agriculture risk management system, high fragmentation and complexity make coherent reform impossible in a single step. The objective of the recommendations proposed in this study is to promote a progressive change at both EU and national levels. These actions will lay the foundations for what can become, in the medium term, a more coherent EU risk management system.

To achieve real change, national insurance systems will need to evolve to increase the availability, affordability and efficiency of insurance products. The high fragmentation of national systems as well as the varied market development, makes a one-size-fits-all approach impossible.

Based on the above principles, the proposed recommendations promote a progressive evolution of current national risk management systems to encourage a more coherent and comprehensive EU risk management system in the medium term. This approach is in line with the current CAP which provides flexible measures that can be adapted to the specificities of national systems.

A centralised **EU Agriculture Insurance Technical Assistance Platform (AITAP) (Recommendation 1)**, is the cornerstone of the proposed strategy and essential to enable the development of centralised EU capabilities, as well as supporting more sustainable national systems. Member States could benefit from knowledge transfer and exchanges, as well as exploring innovative insurance products and complementary risk management interventions to increase insurance uptake, transparency and price efficiency.

270 ESRB advice to EIOPA on the prudential treatment of environmental and social risks European Systemic Risk Board (2024) European advice to EIOPA on the prudential treatment of environmental and social risks.

A precondition for the following recommendations is the creation of the necessary risk information and risk modelling capabilities as an EU open-access service **(Recommendations 2 and 3)**. The proposed EU-wide data and risk modelling platform would increase insurance market transparency and pricing efficiency at national and regional levels. It would guide the design of wider financial tools, public policy and regulations for risk management and adaptation. This publicly available information would also provide essential information to farmers and other stakeholders in the agricultural sector.

A key element of the proposed strategy is to **build common risk-sharing capacity at EU level** to protect farmers against catastrophic risks which threaten the viability of agriculture in the long term and increase pressure on national budgets if they remain the only source of financial response to catastrophic losses.

This implies, as a first step, actions to increase the capacity of current and future EU central emergency funds, using risk transfer mechanisms such as catastrophe reinsurance and catastrophe bonds. Building on this, a dedicated facility to create an EU risk pooling mechanism could be considered. (**Recommendations 4, 5 and 6**).

These EU level recommendations would also provide rapid and significant direct and indirect benefits for national insurance systems:

- EU coverage for catastrophic risks such as drought would increase financial resilience and enable national systems to focus on risks that are more efficiently manageable at a national level. Covering defined extreme events at EU level would also reduce the cost of insurance for farmers because insurers would not need to bear these same risks in their portfolios.
- Appropriate criteria for Member States to access EU level protection would incentivise reforms in national systems, based on the principles mentioned above.

The new CAP framework could be designed in synergy with the actions proposed in this report. An assessment of the current CAP risk management toolkit is outside the scope of this study, but further analysis could be undertaken by the Commission.

Given the growing negative impact of climate events, well-designed adaptation strategies and support for appropriate investments are essential for EU and national risk management strategies. This is relevant not only for catastrophic risks but also for frequent, attritional losses that farmers cannot transfer to insurers or the public sector. These growing losses endanger the sustainability of farming, especially in some sectors and geographies.

Finally, there is a significant risk that access to capital might become more difficult due to climate risk and more restrictive prudential regulations related to the impact of climate events. This requires appropriate coordinated action at EU and national levels (**Recommendations 7 and 8**).

From these foundational steps, the EU can progressively build a risk management architecture configured to better meet climate challenges now and in the coming decades, as well as optimise the use of resources available from EU programmes and risk capital markets to support Member States and the agriculture sector.

PART 5.2: Building knowledge and better risk modelling

RECOMMENDATION 1: EU Agriculture Insurance Technical Assistance Platform (AITAP)

RECOMMENDATION 2: Consistent standards and protocols to collect and assimilate EU crop yield data and related statistics

RECOMMENDATION 3: EU open access to insurance-based agriculture climate risk modelling and metrics

RECOMMENDATION 1: EU Agriculture Insurance Technical Assistance Platform (AITAP)

The development of better EU agriculture risk management tools and adaptation requires adequate knowledge, data infrastructure and risk modelling. The design and implementation of an improved risk management system needs to involve agricultural stakeholders, as well as the insurance sector, government institutions, regulators, research centres and academia.

Across Member States, there is significant and complimentary experience in developing and operating different insurance systems. While each have distinctive attributes and experiences, all Member States share common challenges in evaluating, managing and financing climate risks to agriculture.

A **DG AGRI AITAP is proposed, to provide a purposeful platform to combine and blend that experience,** develop and share collective knowledge and resources (such as risk modelling) and engage with stakeholders.

The initiative should include an advisory board of partners under an appropriate mandate and governance, for example:

- EU institutions from agriculture, climate and financial regulation;
- Member State agricultural institutions;
- Private sector finance including banks, intermediaries and (re)insurers;
- Risk capital markets analytics and expertise;
- Agricultural sector including trade and farmer associations, industry, cooperatives;
- Specialist data, analytics and information technology institutions, including universities.

This initiative could support the European Commission, Member States, regulators, farming communities and insurers with **shared access to resources, technical assistance and collective expertise.** This would guide best practice, including the development of innovative risk financing aligned with insurance instruments and risk metrics. The platform would reduce costs and uncertainties for Members States to address climate risk challenges.

AITAP could be the first recommendation to be implemented, since it is foundational for the development of all other actions proposed in this study. A modest budget, from existing EU technical assistance programmes, might be identified by the European Commission to launch the initiative in the short term. This would enable the feasibility assessment of the following recommendations to proceed with implementation, potentially, in the current Multiannual Financial Framework.

RECOMMENDATION 2:
Consistent standards and protocols for the collection and assimilation of EU crop yield data and related statistics

Europe needs consistent, open-access data on yield and economic loss, from local to national and EU levels. Yield losses are measured in different ways across Europe, posing enormous risk modelling and actuarial challenges for the insurance sector, particularly at the re-insurance level where risk from national insurance companies is aggregated across countries.

A specific challenge identified during the production of this report is the need to establish shared standards for yield data measurement, data collection timing and data assimilation protocols for different crops across the EU.

There are many databases and efforts to collect yields, from sample surveys (e.g. FADN), holistic databases (e.g. EUROSTAT, FAO) to detailed subnational and national sources (e.g. Universities or ministries). The problems include differing yield definitions and values and, more importantly, limited relationships between weather events and yield differences year by year, as well as the economic impact and related insurance coverage.

RECOMMENDATION 3:
Open access information for insurance aligned agriculture climate risk modelling and metrics

To underpin risk understanding, policy development and financial instruments, it is essential to develop and maintain effective and accessible agricultural climate risk models at EU scale, with the necessary detail to evaluate how agriculture climate risk to various crops is distributed within and among Members States.

Effective policy cannot be developed without adequate evidence. Meanwhile, insurance systems, financial instruments and financial markets need a risk information infrastructure with shared metrics, standards and protocols. Until now, there has been limited focus or incentive for public, private or even academic institutions to develop such research and information.

The requirements in this study combined with developments across EU institutions and Member States suggest there is now sufficient shared interest and demand to mobilise this capability.

The opportunity to develop agriculture risk modelling and information resources would align with recent priorities identified by DG FISMA, as well as EU financial and regulatory authorities, to understand the risks these threats pose to:

- prudential management of financial institutions;
- stability of the financial system as a whole.

For example, in 2024, The European Systemic Risk Board (ESRB), chaired by ECB President Christine Lagarde, highlighted:

'Events will become ever more disruptive for society and the economy: droughts causing crop failures…. Climate change is also making vast areas of the planet unsuitable for agricultural or other forms of production…. Such supply-side shocks will be particularly difficult to handle, particularly if fiscal and monetary policies are constrained.'[271]

An earlier analysis by the ESRB identified the exposure of EU financial institutions to agriculture climate-related risks:

'Chronic physical risks would likely accumulate in the agricultural and related sectors, while acute physical risks relate mainly to freshwater. Notably, water-dependent sectors in the EU, such as manufacturing and agriculture, generated 26% of the EU's annual gross value added in 2015. The materialisation of these nature risks could have dire consequences, as European financial institutions are heavily exposed to sectors that are highly dependent on nature.'[272]

271 European Systemic Risk Board (2024) European advice to EIOPA on the prudential treatment of environmental and social risks.
272 European Systemic Risk Board (2023) Towards macroprudential frameworks for managing climate risk.

The analytical requirements to assess EU worst-case agriculture climate risk scenarios applied in this report are also needed to support financial stability, prudential supervision, disaster risk financing and the development of (re)insurance markets. They can also contribute to serving the needs of related financial authorities such as the ECB, EIOPA and the Financial Stability Board.

Data, statistics and climate risk models are also essential to the EU Adaptation Strategy, as outlined by the EU Commission in the communication *Forging a Climate Resilient Europe: The New Strategy on Adaptation and Climate Change, Brussels 24-02021*[273].

The EU-wide data assimilation, agricultural and climate risk modelling and insurance-aligned analysis in this study have taken a first step in this direction. Additional preparatory work is needed to establish how an agricultural climate risk information service could be developed with inputs from public, private and academic entities.

PART 5.3: Managing and financing EU catastrophic agricultural climate risks

RECOMMENDATION 4: Using the risk capital markets to increase the capacity of central EU emergency funds for catastrophic events across the EU

RECOMMENDATION 5: Supporting Member States to arrange additional parametric catastrophe protection to complement their existing national systems

RECOMMENDATION 6: A European Multi-Sovereign Agriculture Insurance Risk Pool

Recent events and the advanced modelling in this report highlights the catastrophic risks faced by agricultural production across the EU-27. Current EU-27 exposure to a 1-in-50 agricultural catastrophe is approaching EUR 60 billion. Looking ahead to 2050, scenarios producing agricultural losses of EUR 90 billion, or more, across the EU in a single year are plausible and foreseeable. The frequency, severity and intensity of catastrophic losses will increase, inevitably and relentlessly, in the years to 2050, even if the world achieves a low or medium emissions pathway.

Member States, EU institutions, the agricultural sector, communities, lenders and investors are largely unprepared for these threats. Until now agricultural catastrophes, such as the 2022 drought, have been met with ad hoc and unplanned allocations from EU and Member State budgets, with insurance and risk capital markets being underutilised. This approach to fiscal and wider financial management of these growing contingent liabilities is economically unsustainable.

A key recommendation is to use the collective scale of the EU to share risks across Member States and internationally via global risk capital markets, to effectively combat the scale of the agriculture catastrophe challenge and support exposed communities. Such an advance in prearranged public-private disaster risk financing would emulate well established developments in other world regions and jurisdictions and provide a means for the EU to innovate using its considerable financial, scientific and institutional assets. Advances in catastrophe risk financing for EU agriculture could align with, support and help to mobilise related objectives of EU financial authorities including the ECB, EIOPA, ESRB, the European Stability Mechanism and the wider policy priorities of DG FISMA and others.

273 European Commission. (2021a). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

Alignment with ECB & EIOPA Proposals for Reducing the Insurnace Protection Gap[274]

In April 2023 the ECB and EIOPA published a discussion paper**, Policy Options to Reduce the Climate Insurance Protection Gap**, which aligns many of the principles described in this report. Its executive summary included the following statements

"The public sector can prepare for contingent liabilities related to climate-related catastrophes by enhancing its ex ante disaster risk management strategy. This could include supporting ex ante contingent financing by creating fiscal buffers, such as national reserve funds. It could also include risk transfer and measures that support private insurance solutions, such as public-private insurance schemes that pool and diversify risks, or capital market products that transfer part of the risk to investors."

"For less frequent, large-scale disasters, an EU-wide public scheme for natural disaster insurance covering a broad range of weakly correlated hazards could complement national schemes. Pooling risks at the EU level could help to reduce the economic costs of catastrophes and accelerate recovery and reconstruction efforts, while incentivising and promoting ex ante risk reduction via both mitigation and adaptation measures.

"Wider EU policy initiatives, such as the capital markets union (CMU), could also help to further develop and integrate EU financial and insurance markets. This could improve the accessibility and size of the pool of private funding available to tackle the climate insurance protection gap."

During the production of this report, the ECB and EIOPA published a follow up report in December 2024 , **Towards a European System for Natural Catastrophe Risk Management: The possible Role of European Solutions in Reducing the Impact of Natural Catastrophes Stemming from Climate Change.** It proposed "a possible EU-level solution to address the widening gap in natural catastrophe insurance protection in Europe including:

- "**An EU public-private reinsurance scheme** to increase the insurance coverage for natural catastrophe risk. By pooling private risks and perils across the EU, this scheme would exploit economies of scale and diversify the coverage of high risks at the European level. It would be funded by risk-based premiums from (re)insurers or national insurance schemes.
- **An EU fund for public disaster financing** to reinforce public disaster risk management in Member States. Financed by contributions from Member States, this fund would help rebuild public infrastructure following natural disasters, subject to Member States having implemented agreed risk mitigation measures prior to the event to minimise moral hazard."

It highlighted that:

- "An EU public-private reinsurance scheme would serve as a permanent stabilising mechanism, enabling risk diversification over time. The scheme would operate as a public legal entity that works to implement the objectives of supporting territorial cohesion and development set out in Articles 174 and 175 of the Treaty of the Functioning of the European Union. Its legal framework could be established through an EU Commission initiative, under existing law, based on Article 352(1) of the TFEU."
- With the following commentary:

274 Policy options to reduce the climate insurance protection gap ECB and EIOPA (2023), Discussion paper.

"Recent events in Europe have shown the challenges the EU and its Member States are facing in dealing with natural catastrophes," said **EIOPA Chairperson Petra Hielkema**. " This calls for coordinated action. The proposals presented are meant to spark a discussion on possible ways to reduce the insurance protection gap through an EU-level solution, while preserving the integrity of national insurance schemes," she added.

ECB Vice-President Luis de Guindos said: "We need to get prepared for the rising climate risks. The proposed solution is one possible way to mitigate the macroeconomic and financial stability risks from natural catastrophes, while also reducing moral hazard."

Recommendations in this report for agriculture climate risk management and insurance could be considered a first step to support the progression of these wider developments.

RECOMMENDATION 4:
Using the risk capital markets to increase the capacity of central EU emergency funds for catastrophic events across the EU

Risk capital markets are pools of capital that provide a contractual entitlement to financial resources in response to defined loss events. Using the scale and efficiency of these markets, central EU emergency funds can multiply the resources available at times of catastrophe in a number of ways, for example with:

- (Re)insurance;
- Catastrophe (cat) bonds;
- A combination of the above through complimentary programmes.

The fundamental principle is the same in all these cases: some form of premium-like payment, in advance, is required in return for financial protection, or coverage, against defined risks. The main difference between these instruments is the source of risk capital they use: (re)insurers' underwriting capital, or capital markets investors for catastrophe bonds.

By enabling access to both markets, EU central funds would benefit from the full range of risk capital available to optimise the design of catastrophe risk layering and obtain best prices and coverage terms. The selection of such market instruments and programme structures would be a function of multiple factors including: coverage details, terms and conditions, capacity availability, price and economic value, financial security and administrative simplicity.

The security and availability of these funds to respond to defined catastrophic events is supervised by financial regulation and informed by the risk modelling metrics applied in this report. In the case of (re)insurers, regulators require that the solvency of their reserve funds for catastrophe payouts are stress-tested annually to extremes exceeding 1- in-200 year thresholds (catastrophic events with a 0.5% annual probability of occurring). Meanwhile, for catastrophe bonds, it is customary that the purchased protection is collateralised with funds held in dedicated and secure custodian facilities for disbursement when required.

Hypothetical example of how this would work:

Part of the existing EUR 450 million per year CAP 2023-2027 Agricultural Reserve[275] could be used to purchase financial protection for a catastrophic drought (or other selected perils), for a 3-year period. The payout from the (re)insurance coverage or catastrophe bond would be designed to trigger when pre-defined drought threshold is reached by a combination of geographic extent, intensity and duration.

Further assessment would be required to confirm the feasibility and optimum use of catastrophe reinsurance and catastrophe bonds. However, these instruments have become well established by governments and public entities in natural catastrophe prone regions around the world. In principle, EU institutions and Member States will likely find benefits from prearranged catastrophe risk financing. These types of approaches have been the described in series of discussion papers published by EU DG Economic and Financial Affairs.[276]

The exact costs and benefits of the coverage would depend on the details of the risks being covered, the results of risk modelling, transaction specifications and market conditions. Any prospective programme would need to be market tested to confirm sufficient market appetite before proceeding with the formal transaction process. However, for the purposes of communication and illustration through a hypothetical example, it is reasonable to consider a scenario where an initial target of up to EUR 1 billion of coverage could be sourced from risk capital markets for defined pan-EU catastrophic events. It is likely that this market would be built in steps and stages over time as EU institutions, Member States, (re)insurers and investors develop greater familiarity and experience of evaluating and financing these EU agricultural climate risks at scale.

Natural catastrophe reinsurance has been well established in the Europe since the 19th century and the EU has some of the world's largest and most respected reinsurance institutions. Meanwhile, over thirty catastrophe bonds have been issued by EU (re)insurers to support their financial security from natural disasters such as windstorms, floods and earthquakes. These are overseen by EU regulators and supervisors. Although the CAP Agriculture Reserve244 was not originally intended to support Member States responding to climate-related disasters, the EUR 450 million per year facility has been deployed in recent years on an *ad hoc* basis. This is likely to continue in future, but the fund risks excessive demands and potential exhaustion in a catastrophic loss year with requests from multiple Member States.

Governance

The development of these prearranged facilities also supports the preparation of the use of such contingent funds in a planned and organised way, so that they can be made available sooner and therefore be more impactful.

These types of disaster risk financing facilities for governments and multi-sovereign agencies are well established in other parts of the world including the Caribbean, North America, Africa, South East Asia, New Zealand and other Pacific island nations.

Allocations to Member States could be used in a variety of ways, as agreed when the programme is established, including:

- Additional catastrophe payments directly to farmers through social security systems or their usual insurance programmes.
- Payments to local authorities for disaster response costs.
- Payments to national governments to offset budgetary shocks and imbalances caused by the extreme event.

Access to the fund for Member States may be conditional on specific access criteria, to create a strong incentive for adaptation and prevention measures, as well as 'build back better' principles in case of payouts.

275 European Parliament (2021b). Regulation (EU) 2021/2116: On the financing, management and monitoring of the common agricultural policy and repealing Regulation. Official Journal of the European Union.

276 Radu, D (2024). Approaching Disaster Risk Financing in a Structured Way.

Additional feasibility technical work carried out by an appropriately regulated insurance and risk capital markets advisory organisation would be required to: i) examine more thoroughly how risk capital markets could be used by EU central emergency facilities, such as the CAP Agricultural Reserve or the EU Solidarity Fund, to support Member States after extreme events and ii) to make initial preparations to support the implementation if it was decided to mobilise such mechanisms, including parametric (re)insurance and catastrophe bonds. As already mentioned, the scope and level of protection could be expanded once additional budget is available and the necessary risk modelling capabilities are developed.

Catastrophe Bonds[277]

What is a catastrophe (cat) bond?

- Invented as an alternative to the traditional natural catastrophe reinsurance market in the 1990s, cat bonds are financial instruments (insurance linked securities) enabling entities with exposure to high impact, low frequency events (typically natural catastrophes) to transfer financial risks to bond investors in capital markets.
- Over the last thirty years cat bonds have grown to provide approximately 20% of overall market capacity for natural catastrophe risk coverage providing offering around $50 billion of protection in 2024.
- Cat bonds are mainly sponsored by insurers and reinsurers to transfer selected catastrophe risks, but they have also been used by Government related bodies including New Zealand (EQC), USA (FEMA); California (CEA), Mexico (Hacienda), Turkey (TCIP), Chile, Colombia, Peru, Jamaica, the Philippines and others.
- It is not a debt obligation for the sponsoring entity (since they do not issue the bond). Investors are attracted to cat bonds because of their diversification benefits: natural disasters occur entirely independently of the dynamics of other financial markets.
- Typically, providing financial protection for 3 to 5 years, sponsors receive a payout when a disaster event meets certain pre-defined criteria. As a fully collateralised transaction, investors stand to lose some, or all, of the principal if a payout is triggered.

How does a cat bond work? The principle of a cat bond can be illustrated through a simplified hypothetical example:

- A country evaluates that a catastrophic drought of defined intensity and duration across specified regions will cause approximately EUR 100 million of losses to crop yields and public budgets. The event has an expected annual probability of 1%, therefore the 'pure' price of risk, or Annual Average Loss AAL, is EUR 1 million per year.
- To transfer this risk the country sponsors a EUR 100 million cat bond, enabling investors to deposit money into the bond in return for an annual coupon. To manage risk, multiple investors usually contribute to a bond and most investors hold a diversified portfolio of cat bonds across different perils and geographies.
- The coupon payments for investors will include the pure price of risk, a margin for risk uncertainty and an expected profit to attract sufficient investment. In this hypothetical example the annual coupon rate might be 3%. In addition, investors will receive the customary money market return on their funds deposited into the cat bond in a custodian bank during the term of the transaction. For the purposes of this hypothetical example, we assume this is 1% per annum making the total return 4% per year, or 4 times the pure cost of risk.

277 About Us | CCRIF SPC CCRIF (n.d.) Company overview.

- If the cat bond expires without a trigger drought occurring the investors will receive their annual coupon and interest payments of 4% and the return of their original capital investment sum. However, if the defined catastrophic drought event occurs, the bond will be transferred to the sponsor within days, and investors will forgo their original investment. In some circumstances the loss triggers can be graduated such that less severe catastrophes will trigger the transfer of a pre-defined proportion of the cat bond to the sponsors.

Some EU considerations

- There has been growing interest in the potential of EU public entities sponsoring catastrophe bonds:
  - A 2023 EIOPA and ECB discussion paper ***Policy options to reduce the climate insurance protection gap*** stated "Policy measures could be undertaken at both national and EU level to foster greater and more effective use of cat bond markets in both the private and public sector, thereby helping to reduce the climate insurance protection gap".
  - This was followed by an EIOPA and ECB joint paper in December 2024 ***Towards a European system for natural catastrophe risk management*** which stated an "EU scheme would supplement national efforts and an EU-wide pool would benefit from the establishment of national schemes….the scheme would seek to complement the private markets and the national schemes rather than compete with them…..The EU reinsurance scheme could seek to transfer part of the risks to capital markets via instruments such as catastrophe bonds. The market for these products is less developed in the EU than in North America. Part of the reason is the smaller scale of the issuances. The EU scheme could explore the feasibility of a pan-European catastrophe bond covering more perils than the bonds currently issued. This would serve the dual purpose of expanding the catastrophe bond market and bringing more niche risks directly to capital markets investors. The investors, in return, could benefit from the additional diversification offered by exposure to these risks relative to the risks currently covered."
- An EU entity may consider sponsoring a cat bond to provide additional financial resources to support EU Emergency Funds for EU institutions and Member States in response to a catastrophic pan-EU drought.
- The EU entity could either engage a risk capital markets broker directly, or coordinate this through an appropriate EU institution, that would use a broker. In either case the essential process would be the same and the funds (coverage premiums and catastrophe payouts) would ultimately flow from and to the sponsoring entity.
- Under this approach, neither the sponsoring EU entity nor the supporting EU institution would carry any risk. Their only costs and financial exposure are to the annual bond coupon payments to investors and the transaction administration expenses to advisers and service providers.
- Approximately 90% of cat bonds are sponsored by US entities which reflects the high levels of catastrophe risk exposure in that economy (including California Earthquakes and East & Gulf Coast Hurricanes). Fewer cat bonds are issued to cover EU risks because of the relatively low levels of catastrophe risk compared to Asia and the Americas. Since 2000, there have been approximately 30 cat bonds issued for European Windstorm risk, 7 for European Earthquake risk and 13 for European Multi-peril risks.
- EU bonds would be a diversifying risk for most cat bond investors worldwide, a likely addition to many cat bond portfolios. However, it would also take time to build the risk modelling resources for different perils, market awareness and investor experience and confidence that has been developed in more established cat bond markets such as the United States and Japan.
- An EU agriculture catastrophe risk financing strategy would require sustained development step by step over the medium to long term.

RECOMMENDATION 5: Supporting Member States to arrange additional parametric catastrophe protection to complement their existing national systems

The objective of this recommendation is to support individual Member States to acquire parametric protection, configured for their own national priorities, for extreme events that fall below the catastrophic EU level.

While Recommendation 4 focuses on a catastrophic event affecting extensive parts of the EU, it is possible to consider circumstances where extreme conditions could affect individual countries but not the EU as a whole. For instance, individual or groups of smaller southern and eastern Member States may suffer an extreme drought that does not extend northwards to other major agricultural regions.

To initiate this process, a modest amount of central EU funding could be made available to support national premium payments. For example, each Member State may have the entitlement to draw down EUR 2 million per year from the Agricultural Reserve or similar EU funding mechanism, to pay for selected parametric protection. This could be complemented with Member States' own contributions to create a payment of EUR 4 million annual premium. This premium could be used to support the Member State's own priorities for catastrophe risk protection, with appropriate technical support and advice, through parametric reinsurance or cat bonds depending on the preference of each country and the coverage, prices, terms and conditions available.

There are multiple advantages to this approach beyond the financial protection:

- Each Member State can develop their own view of risk through risk modelling and risk capital markets.
- It provides a practical means to identify national priorities for protection and make pre-funded contingency plans to address the effects of extreme events on food production and exposed communities.

Additional feasibility and technical work by an appropriately regulated insurance and risk capital markets advisory organisation would be needed to assess the level of interest and demand among Member States for parametric drought, hail, frost, and excess rainfall or other peril protection, and identify modalities to deploy such protection to obtain optimum benefits.

RECOMMENDATION 6: A European Multi-Sovereign Agriculture Insurance Risk Pool

As Member States attain greater experience and awareness of disaster risk financing and related markets, there may be advantages in creating a multi-sovereign risk pool, as other parts of the world have already implemented.

The major step here is that Member States share their agricultural climate risks *among* each other in a collective and not-for-profit risk pool, forming a mutual insurance entity. Extreme risks and catastrophe exposures to the inter-state risk pool would be reinsured through the risk capital markets, to ensure that the risk pool would be able to meet its obligations during catastrophic loss years.

A multi-sovereign risk pool could support Member States in a number of ways:

- It could provide economic, risk reduction and governance benefits by encouraging a collective interest in reducing risks and a collective responsibility to use payouts effectively.
- Beyond catastrophe risks, the facility could support public-private insurance systems in responding to lower-level events which would in turn fill protection gaps for exposed regions and communities.
- It would strengthen collective understanding and institutional cooperation around agriculture climate risks and broader natural hazards.
- In due course, the facility could embrace funding by 'risk-based premiums from (re)insurers or national insurance schemes', in line with EIOPA-ECB recommendations on an EU public-private reinsurance scheme.

Further assessment would be necessary to identify how a multi-sovereign EU risk pool could share agricultural risks between Member States, and support the expansion and development of national agricultural insurance systems within Member States.

Existing examples

Regional sovereign risk pools have become established mechanisms in the last two decades since the creation of the Caribbean Catastrophe Risk and Insurance Facility (CCRIF-SPC) in 2007. CCRIF has become the standard approach for sovereign disaster risk financing across the region, with 19 Caribbean and 3 Central American government members receiving sovereign protection from hurricanes, excess rainfall and earthquakes. Excess risks of the pool are covered by catastrophe protection from risk capital markets.

In 2012 African Risk Capacity (ARC) was founded as a specialised agency of the African Union and two years later ARC Insurance Company was founded as a hybrid mutual insurer owned by the participating countries. By 2025, ARC had 39 African Union member states responsible for setting the direction of the organisation's Disaster Risk Management research and policy. Member states can also access ARC's Disaster Risk Management services, including the Africa Risk View software, the ARC Capacity Building Programme and ARC Ltd.'s risk transfer services. ARC also arranges catastrophe protection from risk capital markets to ensure the security and solvency of the mutual risk pool.[278]

ARC is supported by international donors including the EU and individual Member States including Germany (BMZ & KFW), Sweden (SEDA), France (AFD), and the Netherlands (MoFA).[279]

In recent years, two other sovereign risk pools have also been created, the Pacific Catastrophe Risk Insurance Company and the Southeast Asian Disaster Risk Insurance Facility.[280]

PART 5.4: Enhancing agriculture adaptation and resilience

RECOMMENDATION 7: Promote a more holistic approach to adaptation across EU instruments and policies

RECOMMENDATION 8: Support stable access to finance for famers and rural areas

RECOMMENDATION 7: Promote a more holistic approach to adaptation across EU instruments and policies

A strategic commitment to sustainably finance climate adaptation at farm, local and regional levels will be essential to contain agricultural risks within tolerable parameters and maintain commercial viability for farmers in exposed regions.

Adaptation to the inevitable consequences of climate change is already a top priority for the EU, as outlined in the EU Climate Adaptation Strategy.[281] While there is consensus that the current level of investment in adaptation is insufficient, various EU funding sources are available to support this, with CAP being the main policy tool to promote adaptation in agriculture.

278 African Risk Capacity (ARC) (n.d.) Who we are.
279 In 2022, the EU Commission granted ARC €9 million to support efforts to: i) strengthen disaster risk financing and insurance responses to natural disasters in Africa, and ii) ensure its members can better protect their vulnerable populations against climate-induced disasters, outbreaks and epidemics.
280 Pacific Catastrophe Risk Insurance Company.
281 The SEADRIF initiative SEADRIF (n.d.) The SEADRIF initiative.

CAP Strategic Plans support farm investment as well as sustainable farming practices under CAP eco schemes. The sector can also benefit from other EU programmes for larger projects, such as irrigation and flood protection infrastructure. In addition, the EIB is also active in financing adaptation investments at different levels in line with the EIB Climate Adaptation Plan.[282] Advisory programmes are also available, such as the Climate-ADAPT platform of the European Commission, which also covers adaptation in agriculture.[283]

Grant schemes, financing and advisory programmes for adaptation in agriculture, including under CAP, are very fragmented with diverse levels of ambition at national and regional levels. The lack of unified benchmarking and certification for sustainable practices and investments, including for adaptation, hinders consistency among public support programmes and makes it even more difficult to attract additional finance from the private sector.

The proposed EU Agriculture Insurance Technical Assistance Platform could also promote a more holistic approach to financing adaptation, in collaboration with stakeholders such as financial institutions and (re)insurance providers. This would enable a range of complimentary EU policies and programmes to be integrated.

Maximum impact will be achieved when the objectives of resilience and regenerative agriculture are incentivised by comprehensive and mutually supporting investment, credit and insurance programmes operating at farm and financial intermediary level.

Among other actions, the AITAP could promote:

- Information and risk modelling proposed under recommendations 2 and 3 to **identify adaptation needs at regional and local levels**. This would enable more effective adaptation planning at all levels, including a clear indication of economic benefits, as well as the costs of no-action.
- Based on this, **unified benchmarking could identify adaptation practices and investments.** This would facilitate a more targeted and effective use of CAP subsides, particularly under eco-schemes. In addition, it would attract additional resources from private and public financial institutions, which would benefit from this system for their mandatory and voluntary disclosure.
- Clear identification of adaptation practices and investment would also increase **efficiency in the insurance market**, since lower risks for farmers undertaking adaptation should be transparently reflected in lowered insurance premiums. Once there is reliable benchmarking, CAP subsidies for insurance premiums might also be reviewed to reflect adaptation and investment. Access to public subsidies for insurance premiums should be progressively subject to implementing prevention and adaptation measures.
- Given the significant public goods, externalities and information asymmetry failures related to adaptation investments, **blended financial instruments** (e.g. combining financial instruments with grants) could attract more private finance and increase the impact of adaptation investments.
- The **direct participation of insurance and reinsurance companies in such financial instruments or in a Pan-EU resilience and adaptation fund might also be explored.** This would require an appropriate legal framework and the use of EU budget to de-risk private investor participation, in particular for (re)insurance companies. The participation of insurance companies as investors in such a fund might be limited by the current regulatory framework. Both the Letta[284] and Draghi[285] reports highlight the role of insurance companies as investors to close the EU 'productivity gap'. However these reports also underline the need to review the current regulatory framework to unlock this potential.

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RECOMMENDATION 8:
Support stable access to finance for farmers and rural areas

As part of wider reforms to financial regulations, banks and other financial intermediaries are required to disclose current and future exposure to physical climate risks in their loan books and investment portfolios. Until now, these disclosures have been relatively qualitative and descriptive, but this is changing, and lenders are starting to be required to quantify their risks.

This may require banks to manage their physical risk exposure to farmers, tightening credit conditions and reducing capital allocations to higher risk agricultural areas. Credit droughts may combine with climate drought to make farming even more precarious in some regions. In addition to the direct risks of climate-induced farm cashflow and loan default risk, the impact of climate risks could have a cascading effect on decreasing farm valuations and collateral values, as well as increasing stranded assets as the prospect of finding buyers at profitable valuations diminishes.

Some public and private financial institutions already believe they need to provide better assistance to their clients through tailored advice and innovative financial products. This would improve the climate risk governance of their portfolios, as illustrated in Part 4.4 of this study. Improved assistance would include improved risk metrics, more flexible repayment structures and provision of liquidity, as well as working capital facilities that respond better to climate impacts.

The AITAP (see Recommendation 1) could conduct further analysis and promote discussions among all stakeholders, such as the farming community, financial institutions, insurance companies and regulators on how climate change might impact credit for the farming sector and propose appropriate actions.

The AITAP could also analyse and promote discussions among stakeholders on:

- How insurance-based risk modelling can facilitate transparent management of physical risks within agricultural loan portfolios, ensuring this avoids credit restrictions for farms.
- Promote knowledge transfer on innovative financial products with climate-responsive repayment structures for the agriculture sector and how these could be supported through public and private sector financial instruments.
- Evaluate hybrid products combining lending and insurance protection to reduce uncertainty and promote further credit and investment for the transition of the agriculture sector.

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Annex II: Methodologies

Methodology for crop and livestock combined estimates

While this report focuses on crop losses due to climate impacts, it also provides high-level estimates of livestock risks as a supplementary analysis. These estimates are indicative guidance rather than a comprehensive assessment, and are based on losses from past events, adjusted for expected impacts under current and projected climate conditions.

Livestock production, including meat and dairy, accounts for nearly 50% of EU agricultural output. Climate-related factors such as drought and heatwaves directly affect livestock yields by reducing pasture availability and impacting animal health. Secondary effects including the spread of pests and diseases add to climate-related risks for the livestock sector.

For a more comprehensive picture of climate risks, the following livestock-related impact categories are included in this analysis:

- **Livestock Annual Average Losses (AAL):** Estimate based on empirical analyses of past weather event impacts on livestock production, excluding disease-related losses.
- **Livestock Disease Annual Average Losses (AAL):** Derived from limited available empirical data on climate-induced disease impacts in select Member States.
- **Transformation and Services Factor:** Applied to account for economic value lost in processing and transforming both crop and livestock products into final agricultural outputs.

These estimates provide a preliminary assessment of livestock-related climate risks. Further research and data collection would be required for a more detailed and comprehensive evaluation of the sector's exposure and vulnerability.

Methodology for Insurance System Classification Matrix

Historical agricultural insurance market data were compiled from a wide range of sources, including:

- **(Agricultural) Insurance Associations:** These often partner with government agencies, private insurers and international institutions to provide coverage and ensure sustainability in agricultural risk management. In addition, they gather, manage, analyse, and publish comprehensive data about the (national) agricultural insurance market.
- **(Agricultural) Insurance Companies:** Insurance companies with large shares of agricultural insurance in a country often publish their own data and annual reports with detailed insights into crop (and livestock) insurance policies.
- **EU, government and ministry reports:** Such publications analyse national (agricultural) insurance markets to identify gaps and areas for improvement in coverage, accessibility and risk management.
- **Scientific literature:** Agricultural insurance is a popular topic in research papers, theses and scholarly articles. Some data was extracted from tables and supplementary material. Often scientific literature was used to find references to the original insurance data sources.

- **News articles and press releases:** When comprehensive data about agricultural insurance were not easily accessible, news articles and press releases gave an overview of the agricultural insurance market in individual countries.
- Firstly, extensive compilation of raw data and source links were compiled across all EU-27 countries. For the 10 case example countries (France, Sweden, Germany, Italy, Spain Poland, Austria, Netherlands, Romania, Greece), a deeper (literature) search and data compilation was carried out based on the initial search results. More detailed results of this research were compiled into five sections:
- Overall losses and damage by peril;
- Premium per crop and other data per crop visualisation;
- Claims to premiums ratio;
- Crop insights by peril;
- Subnational Spatial joins and graphics.

The information in these country tables was translated into English and additional visualisations created to enhance the clarity and accessibility of the information, facilitating cross-country comparisons and deeper analytical insights.

Methodology for Risk Modelling of the PML curves as part of the agricultural outputs for different hazard types

The approach integrates a modelling framework to capture both broad historical yield variability and detailed peril-specific risk:

- Historical Yield Baseline Analysis: A full EU, crop-level analysis using an Olympic average yield approach with rolling 5-year and 10-year windows. This provides a baseline 'normal' yield for each crop and country, against which actual yields are compared to quantify shortfalls. This leverages consistent EU country crop production and cultivated area to compute national yield reductions combined with historical data from insurance data, government sources and CATDAT.
- Peril-Specific Probabilistic Modelling: An analysis of yield loss distributions for selected crops and natural perils. This simulates the impact of four major weather hazards – drought, excess rainfall, frost, and hail – on yields of representative crops depending on crop grouping (winter wheat, winter barley and maize). Yield loss severities are estimated for various return periods (e.g. 1-in-10, 1-in-50 year events), and a beta probability distribution is fitted to derive frequency-weighted yield loss bins per hazard.

By combining insights from data and probabilistic modelling, we capture both aggregate yield risk (regardless of cause) and peril-specific effects given the lack of a consistent data on peril-specific yield losses. The historical baseline approach reflects all factors affecting yield (including technology trends and any peril), while the probabilistic model isolates the contribution of specific extreme weather perils.

The first crop-specific yield losses were calculated using the Olympic average yield approach to establish baselines and identify yield loss events at crop and country level across the EU. In agricultural risk analysis, an "Olympic average" typically means taking a series of recent years, discarding the highest and lowest values, and averaging the rest. We applied this concept on rolling windows of the past 5 years and 10 years for each crop-country combination:

5-year Olympic average baseline: For each year (after an initial 5-year build up), we compute the average yield of the previous 5 years excluding the single highest and single lowest yield years. This provides a baseline that reflects recent yields while smoothing out one-off anomalies (extremely good or bad years).

10-year Olympic average baseline: Similarly, using the previous 10 years' yields, dropping the highest and lowest, and averaging the remaining 8. This longer window provides an even more stable baseline, less sensitive to short-term fluctuations, while still adjusting over time for technology trends or gradual climate shifts.

By using two baseline lengths, we tested sensitivity to the baseline definition. A 5 year window captures rapid changes and recent climate anomalies but might label more years as 'losses', whereas a 10-year window gives a more conservative baseline (losses are only identified when yields deviate significantly from a decade-long norm). Both baselines were calculated using official EU agricultural statistics on annual crop production and area harvested. In practice, for each country and each crop (e.g. France-wheat, France-barley, etc.), we obtained a time series of yield (typically in tonnes per hectare) derived from production divided by area. This data was sourced from EUROSTAT to ensure consistency across countries.

This historical yield approach provides a view of the frequency and severity of yield losses without needing to attribute causes. It captures the combined result of all perils and agronomic factors each year. Notably, by using national average yields it captured widespread events (like a regional drought that lowers yields across large areas), but does not fully reflect highly localised disasters (a hailstorm might devastate a district but barely register in the national average yield if other areas were unaffected), thus official production cost data gave insights into the yield losses by each crop type, but does not provide insights into what may occur in the future, or key drivers behind the losses.

Creation of empirical-hybrid PML curves

The PML curves were developed using an extensive, multi-method approach, integrating historical agricultural damage data, advanced statistical techniques and expert judgement. This aimed to produce reliable loss estimates for multiple hazards across various countries, providing a broad understanding of agricultural risks in Europe, for use at national level backed up by:

a. Data Collection and Validation

Historical damage data was compiled from a wide range of sources, including:

- **Insurance industry data**: Loss records from insurers provided critical insights into agricultural impacts across a range of hazards.
- **Government and ministry reports**: National datasets and publications from agricultural ministries detailed the extent of damage and recovery costs.
- **Agricultural cooperatives**: Local data from cooperatives added granularity to the dataset, particularly for specific crop types.
- **Historical records**: Archives and disaster databases supplied information on past extreme events and their impacts on agriculture including CATDAT.
- **Public databases**: Sources such as EUROSTAT and Farm Accountancy Data Network (FADN) provided key data on crop yields, production values, and market conditions, however less on loss data.

Each country's dataset included multiple estimates of damages from different disasters. These estimates often varied significantly due to differences in reporting standards and methodologies. To address these discrepancies, expert judgement was applied to validate and reconcile the data. This process involved cross-referencing estimates with contemporaneous agricultural production data, such as yields and crop prices at the time of the event. This triangulation ensured consistency and accuracy in the final estimates.

b. Hazards and Countries

The choice of the key hazards to analyse was made on the basis of a process at the start of the project investigating the key drivers of insurance and total damages in the agriculture sector at the EU and country level over differing time periods depending on the country.

The analysis covered a range of hazards, including drought, hail, excess rainfall and frost for the 27 EU countries designated within the main text. We concentrated on four natural hazards - drought, excess rainfall (waterlogging/flood-related yield impacts), frost, and hail - identified as the most material perils for EU crop yields and insurance. This selection is grounded in both historical impact evidence and practical modelling considerations. Empirical studies and insurance data indicate that prolonged drought (often coupled with heatwaves) is the single largest driver of crop yield losses in Europe, capable of causing widespread harvest failures. For example, in Germany an estimated 54% of weather-related crop production losses over 1990–2013 were attributed to drought effects.

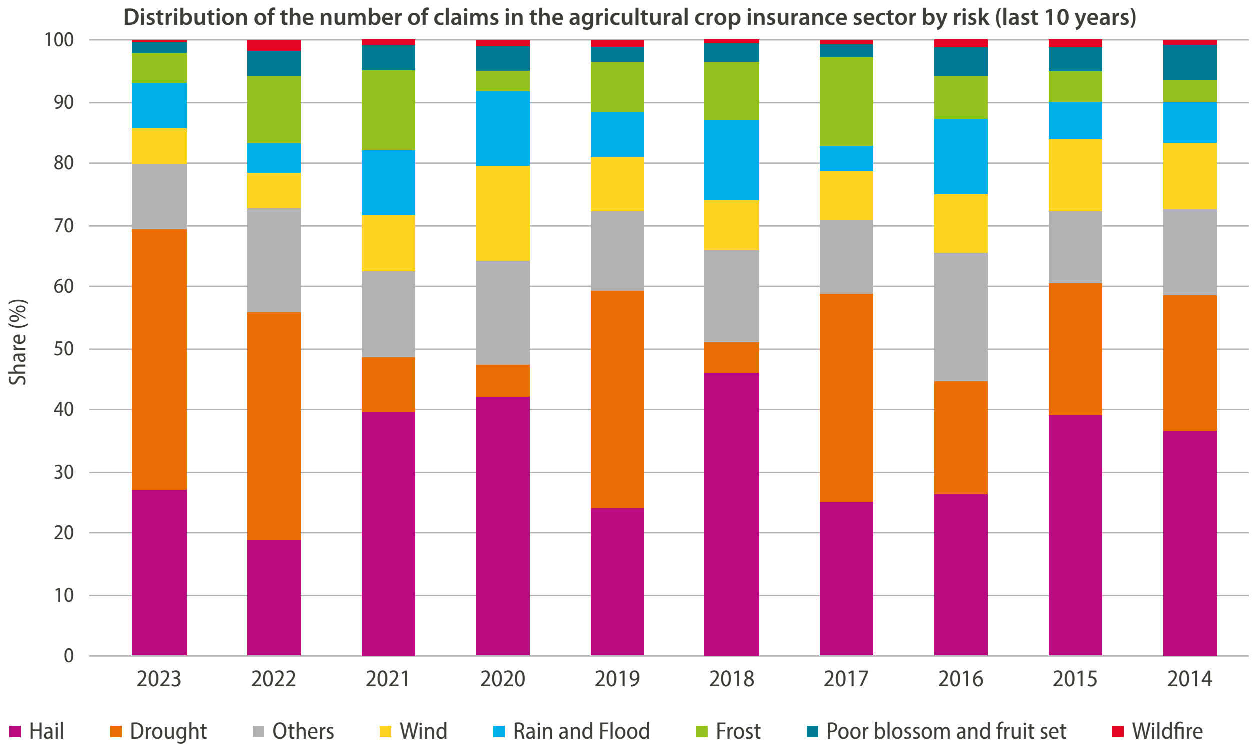
When examining the insured and total damage data in agriculture in the EU, within these broad classifications, the raw damage and loss data for drought for instance, often includes damage due to heat stress and pest as insurance and damage data often includes it within one classification of the main driver and there are strong correlations between these.

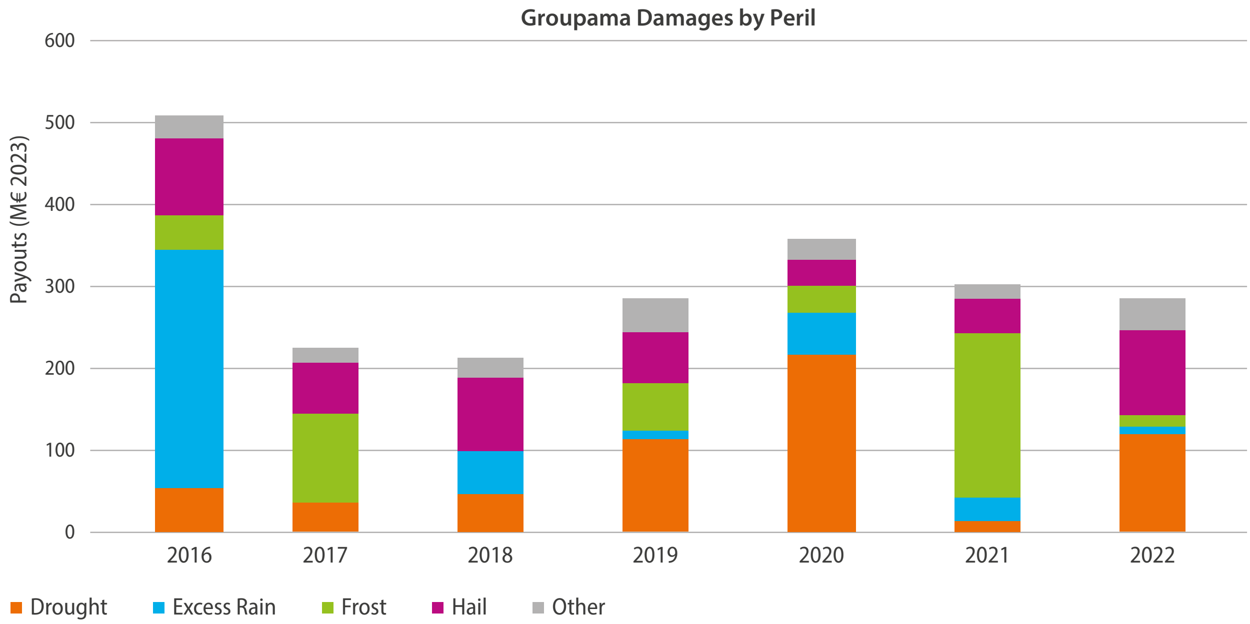
As part of this process the historic losses were investigated with respect to the peril type and crop type where possible. From this the key drivers for a large percentage of the damages were identified as being drought-heat stress, hail, frost and excess rainfall/flood.

Other perils (such as extreme winds/storms, pests/diseases, or isolated heat stress events) were not explicitly modelled because their contribution to aggregate yield losses is comparatively minor and because of the time constraints and difficulty in modelling these perils where little damage data exists. In particular, wind storms and pure flooding were found to contribute less than 20% of crop losses when combined with frost in historical analyses.

Thus, we focused on the four perils above as they capture the majority of weather-related yield risk in Europe's agriculture. This selection was also practical: robust data or models exist for these hazards (e.g. drought indices, hail event frequencies), enabling a peril-specific quantification, whereas other threats were beyond the scope of this study. In summary, the four chosen perils are supported by both impact evidence and feasibility of modelling, balancing completeness with analytical depth.

Figure 69: Shares of damages in France from Groupama and in Spain showing the different peril drivers of agricultural losses.





Drought

Drought primarily affects cereals, legumes, and tree crops by reducing water availability during critical growth stages.

Key parameters include:

- Soil Moisture Deficit:
  - Insufficient soil moisture, especially during critical growth stages (e.g., tilling, flowering, and grain filling in cereals), results in stunted growth and reduced yields.
  - Tree crops experience stress when drought conditions persist through the flowering or fruit-setting periods, leading to smaller fruit sizes or premature fruit drop.
- Crop Type and Root Depth:
  - Cereals like wheat and barley have shallower root systems, making them more vulnerable to topsoil moisture deficits.
  - Deep-rooted crops, such as olive trees or almonds, are more resilient to short-term droughts but still suffer in prolonged dry spells.
- Heat Stress:
  - Drought often coincides with high temperatures, exacerbating the stress on crops.
  - Prolonged exposure to temperatures above crop-specific thresholds (e.g., 35°C for cereals during flowering) can cause sterility or aborted grain development.
  - Tree crops experience cumulative effects over multiple drought years, with diminished flowering potential in subsequent seasons.

Hail

Hail is one of the most damaging hazards for agriculture, particularly for horticulture and viticulture. The key parameters influencing hail damage include:

- Hailstone Size:
  - Hailstones larger than 5 mm are capable of damaging tender buds, flowers, and young shoots, particularly in vineyards and orchards during the early growth stages.
  - Hailstones larger than 20 mm often result in widespread damage, shredding leaves, smashing fruit, and causing direct physical damage to stems and branches.
- Impact Intensity and Velocity:
  - The kinetic energy of hailstones, influenced by their size and velocity, determines the extent of damage.
  - Crops with large leaf surfaces, such as lettuce or spinach, are particularly vulnerable to shredding, while the structural integrity of vines and trees may be compromised in severe events.
- Timing of the Event:
  - Hail events during the flowering stage or before fruit set have a disproportionately large impact on yield, as they destroy reproductive structures.
  - Post-harvest hail can still damage stored produce or residual growth needed for the next season.
- Crop Susceptibility:
  - Horticultural crops (e.g., tomatoes, capsicums) and viticulture (grapes) are highly susceptible due to their tender and exposed structures.
  - Tree crops like apples and pears can sustain permanent damage to branches, reducing future productivity.

Flood/Excess Rainfall

Flooding impacts a broad range of agricultural sectors, with key parameters including:

- Duration of Inundation:
  - Prolonged waterlogging (>48 hours) can suffocate root systems, causing wilting, disease, and crop failure.
  - Sensitive crops such as vegetables (e.g., carrots, onions) are particularly vulnerable to waterlogging.
- Sediment Deposition:
  - Floodwaters deposit silt and debris, smothering crops and contaminating the soil.
  - Fine sediment can block root aeration, while coarser debris can physically damage stems and leaves.
- Timing of the Flood:
  - Floods during the early stages of crop development (e.g., sowing or germination) can lead to total crop loss.
  - Late-season floods often result in un-harvestable crops due to contamination or physical damage.
- Salinity Intrusion:
  - In coastal areas, flooding can introduce saline water into fields, reducing soil fertility and harming salt-sensitive crops.

Frost

Frost primarily impacts vineyards, orchards, and other perennial crops, with critical parameters being:

- Critical Temperatures:
  - Frost occurs when surface temperatures drop below 0°C, freezing plant tissues. For many crops, damage begins as temperatures fall below -2°C.
  - Vineyards experience severe damage when temperatures drop below -1°C during budding and flowering.
- Growing Degree Days (GDD):
  - Frost vulnerability is closely tied to the timing of budburst, which depends on the accumulation of GDDs.
  - Early budburst due to warm spring conditions can increase exposure to late frosts, resulting in damaged flowers or nascent fruit.
- Ice Formation:
  - Frost causes intracellular ice crystals, leading to ruptured cell walls and tissue necrosis.
  - Sensitive crops like grapes, apples, and cherries are particularly prone to flower and fruit damage.
- Radiation Frost vs. Advection Frost (both types have caused historical damage in EU)
  - Radiation frost occurs on clear, calm nights when heat escapes from the soil, freezing plant surfaces.
  - Advection frost occurs when cold air masses move in, chilling entire regions. This type is harder to mitigate and can cause extensive damage.

Agriculture Hazard exceedance curves

To quantify the probability that a certain amount of agricultural area is affected by a certain peril, hazard exceedance curves have been computed. They describe the probability that a certain amount of crop area in a country is affected by a minimum threshold of a given peril. For example, it describes the probability that at least 1% of a country's wine producing area is affected by a late spring frost. To achieve this, for each assessed country the occurrence of a hazard has been spatially correlated with the distribution of crops within that country.

a. Methodology

Since many climatological perils are defined as either a certain amount of days during which a certain climate condition is exceeded or as an average state of a climate condition, the time window of their respective occurrence is important. For example, the number of frost days is such a condition, or the average amount of soil moisture available during a certain time of the year.

A growing season is typically defined by when a certain threshold of growing degree days is reached. Growing degree days (GDD) are defined as the cumulative number of daily average temperatures (often calculated as the average of maximum and minimum daily temperatures) above a minimum threshold. This metric is used to predict plants' growth phases as they need a minimum amount of heat accumulation to trigger growing or germination after winter. It helps farmers, agronomists, and researchers estimate the timing of critical or vulnerable growth phases, such as germination, flowering, and maturity. GDD is based on the idea that plant growth is temperature-dependent and occurs only when temperatures exceed a certain baseline threshold.

The most common formula for calculating GDD is:

$$\mathrm{GDD} = \frac{(T_{max} + T_{min})}{2} - T_{base} \quad \text{if} \quad \frac{(T_{max} + T_{min})}{2} > T_{base}$$

With

- T_{max} = daily maximum temperature (°C)
- T_{min} = daily minimum temperature (°C)
- T_{base} = base temperature (°C) below which growth does not occur

In very hot climates and depending on the crop, GDD is sometimes limited by T_{upper} at which plant growth is saturated to avoid overestimation of growth. Thresholds for growth phases depend heavily on crop types. GDD ranges from about 100-degree days for wheat to 600 degree days for grapes. Here, GDD is counted from February 1st.

In addition to GDD, specific peril-dependent time windows have been defined at which their occurrence are especially harmful to crops. For impactful low temperature conditions, 1st February until end of May or reaching sufficient GDDs depending on crop type are considered, and earlier or later low-temperature conditions are uniformly neglected. Similarly, for all other conditions, like drought or precipitation, the complete time window of March until September are taken into account independent of the growing phase of each crop type.

b. Data and Parameters

To get a representative subset of crops, a small crop selection was used with commonly known data about growing phases with respect to GDDs or frost resistance thresholds matched to the full agricultural production within the country. For horticulture, apples were used as a proxy for most fruit while potatoes were used as a representation for most vegetables to make up horticulture. These were picked due to their average growth phase. Future enhancements can also cover additional horticulture species like lettuce, cherries and many other types. Viticulture is solely represented by a general description of grapes. There is currently no differentiation between grape types but could be a future extension to cover the individual demands of e.g. Riesling or Pinot Noir. Cereals are covered using the 3 most used crops: maize, wheat and barley. Again, future updates could further differentiate e.g. between sweet corn and maize or different varieties of winter and summer wheat as well as e.g. rye. For each class in the country production statistics, thus proxies were made and then adapted.

The proxies were chosen because they are widespread and cover distinct crop categories (winter cereals vs. horticulture) with different growth cycles. Although we did not explicitly model every crop in the probabilistic framework, we assume these examples are indicative of broader crop groups' risk profiles. Each crop's sensitivity to specific perils was considered by tailoring the hazard impact model to its growing season: for instance, winter cereals (wheat, barley) can suffer drought during grain filling, or frost damage if late cold snaps occur in spring, whereas pasture is highly sensitive to summer drought (affecting grass growth) but less so to spring frosts once growth has resumed. By using crop-specific historical yield data and phenological information, the modelling implicitly captures differences in vulnerability – e.g. wheat and barley yields respond differently to a given drought intensity than pasture would. In summary, while not every minor crop is individually modelled, the selection of major crops ensures that the lion's share of EU agricultural output is represented, and crop-specific sensitivities to perils are accounted for within those representative cases, but this is a key source of uncertainity and future research.

Using the spatial distribution of crop areas in each country taken from CROPGRIDS, for every year between 1960 and 2023, different perils are computed.[286]

The climate data is based on the latest ERA5 reanalysis dataset which provides hourly data on ~25km resolution for relevant input parameters to compute the requested perils. Those input parameters cover temperature 2 metres above ground, precipitation and soil moisture at different depths. Each peril has been reduced to a single representative value per year:

- Last Spring Frost: A measure of GDDs which represents the state of plant growth. The larger this value the more developed is a crop and the more vulnerable it is to frost conditions.
- Frost days: Number of days with minimum temperatures below zero within a certain time frame (e.g. March – May).
- Minimum temperature: Absolute minimum temperature in March – May. Absolute minimum temperatures help to identify extraordinary conditions of low temperatures at which whole plants can be harmed.
- Maximum temperature: Absolute maximum temperature in March – September. This is a relevant proxy to assess both heat and drought risks as well as potential pest pressures under elevated temperatures.
- Strong precipitation days: Number of days with a precipitation of at least 10mm/day in March – September.
- Extreme continuous precipitation: Maximum total amount of rain during a 5-day period in March – September.
- Soil moisture anomaly: Average soil moisture ratio with respect to the 1960-1990 average in March – September. Here, soil moisture for the uppermost soil layer is considered (0-7cm), which captures especially short-term drought conditions by describing the immediate water availability of crops. It is also highly correlated with several other key drought parameters both on the climatological side (Standardized Precipitation Index / SPI) as well as on the vegetative side (Normalized Difference Vegetation Index / NDVI). Thus, it is an excellent parameter to assess observed drought conditions.

c. Affected Area Statistics

For each peril, spatial percentiles were calculated, weighted by the respective crop area. This approach determines metrics like the average rainfall amount over a specific period for different crop area percentiles (e.g., 1%, 5%, 10%, or 33%) within a country. The relevant crop area percentile varies depending on whether the extreme associated with the peril corresponds to high values (e.g., frost or heavy precipitation) or low values (e.g., minimum temperature or soil moisture). As the assessed crop area decreases, the average peril intensity in that area increases. This is because extreme events, such as intense rainfall, are typically spatially limited. When averages are calculated over larger areas, extreme values tend to be diluted, potentially becoming statistically negligible.

286 CROPGRIDS: A global geo-referenced dataset of 173 crops | FAO Food and Agriculture Organization of the United Nations (n.d.).

For example, in assessing low-temperature conditions, we calculated the average number of growing degree days accumulated before the last occurrence of spring frost for different crop area percentiles. The 1st percentile represents the 1% of the crop area within a country with the highest number of growing degree days before the last frost. Conversely, as the crop area percentile increases, the average number of growing degree days across the region decreases significantly.

Similarly, for precipitation between March and September, we calculated the average number of intense rainfall events per year for different crop area percentiles. While the average number of such events across an entire country may be low, small patches of land may experience severe rainfall from convective storms each year. The likelihood of a larger proportion of the total crop area experiencing these severe events simultaneously, however, is much lower – but the damage potential overall changes depending on the intensity change in the climate parameter. These types of statistics were produced for use within the yield damage determination, married to past event yield reductions.

A detailed analysis for each of the EU countries has been made at the country level with regard to their yield differentials via the Olympic Yield Index method. This provided indications of the total yield loss for each crop type, but not by peril. However, in the insurance and total damage loss sets extracted from the individual countries, the break down by peril was present for many of the countries.

d. Probability Model

Considering almost 65 years of climate data, an occurrence probability for exceeding certain thresholds can be calculated for each percentile of the crop area. In most cases, these occurrence probabilities follow a normal distribution. In case of extreme continuous precipitation, the normal distribution has been replaced by a lognormal distribution due to the nature of intensity scaling of such events. For frost days, an additional probability had to be introduced, especially for warm and temperate countries, which does assess the general probability of having at least 1 frost day. If there are frost days, their total amount per year follows again a normal distribution. This leads to the following description:

The exceedance probability of a climate variable above a threshold $\mathbf{T}$ can be described using the properties of the normal distribution with a mean $\boldsymbol{\mu}$ and standard deviation $\boldsymbol{\sigma}$, the exceedance probability $\mathbf{P(X>T)}$ is calculated as:

$$\mathbf{P(X > T) = 1 - P(X \leq T) = 1 - \Phi(\frac{T - \mu}{\sigma})}$$

where $\boldsymbol{\Phi}$ is the cumulative distribution function (CDF) of the standard normal distribution. When assuming that the data is following a lognormal distribution, the formula above adjusts to:

$$\mathbf{P(X > T) = 1 - P(X \leq T) = 1 - \Phi(\frac{In(T) - \mu}{\sigma})}$$

In case of frost days, when the overall probability of frost is considered independent of the discrete probability of how many frost days to expect if there is frost, the formula is adjusted the following way:

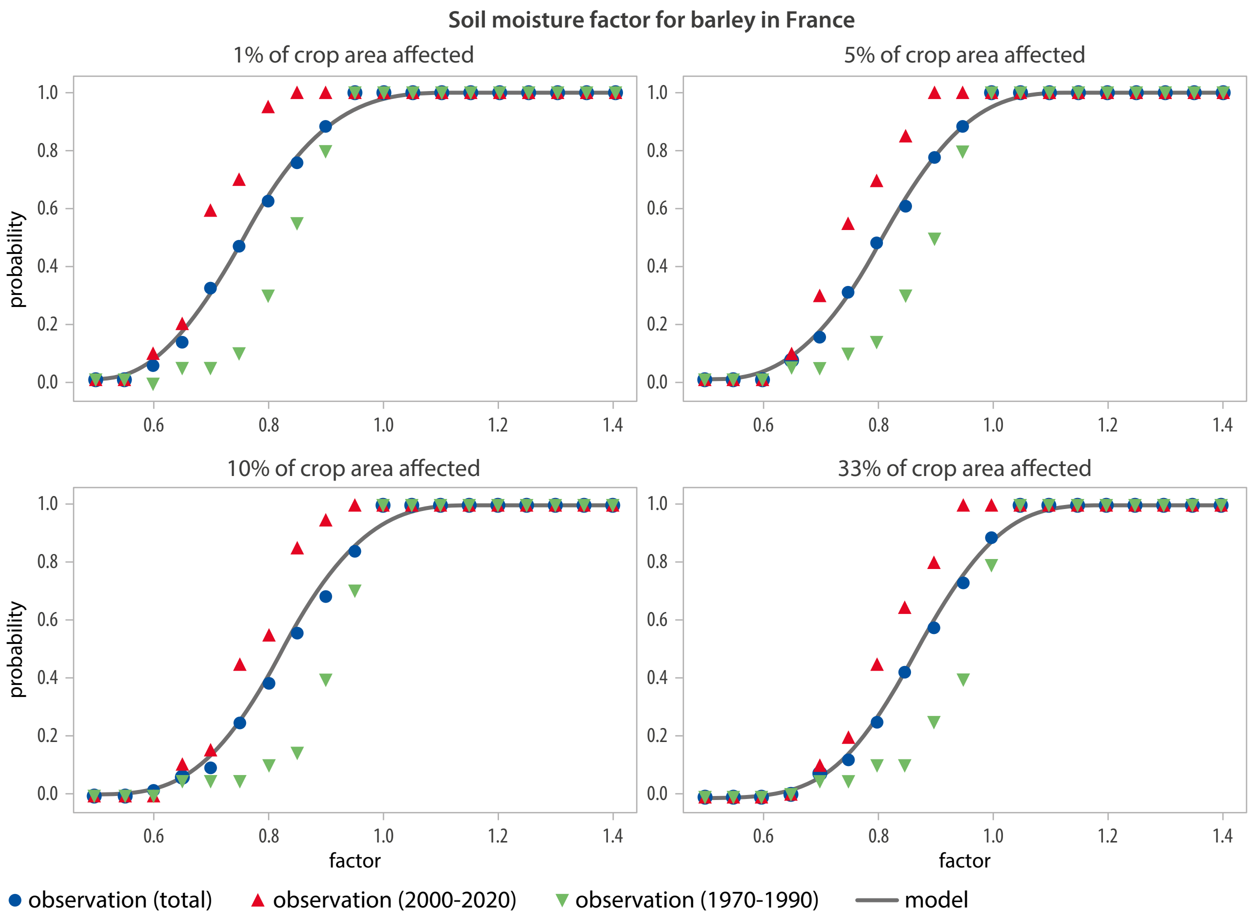
$$\mathbf{P(X > T) = P(X > 0) \cdot P(X > T \mid X > 0) = p_0 \left[1 - \Phi(\frac{T - \mu_+}{\sigma_+})\right]}$$

Where $\mathbf{p_0}$ is the probability that $\mathbf{X > 0}$ and $\boldsymbol{\mu_+}$ and $\boldsymbol{\sigma_+}$ are the mean and standard deviation calculated only for non-zero values of $\mathbf{X}$.

Using normal or lognormal distributions as the foundation of the probability model, trends in average occurrence statistics can be assessed for different time periods by comparing their long-term mean. For example, the average soil moisture has dropped in many places in Europe over the last decades indicating an overall elevated drought condition. This leads to a reduced average soil moisture ratio when comparing 1980s to 2010s conditions. Similar comparisons can be done for all other perils as well.

Figure 1 shows an example of such probability curves highlighting both the changes between different shares of crop area as well as the shift between 1980s and 2010s climate conditions. Low values of soil moisture are considered as a hazardous condition. As described above, the smaller the area-percentile, the lower the probable soil moisture.

Figure 70: Probability curves for the average annual soil moisture conditions for barley in France for different shares of the total crop area. Red dots indicate the conditions for 2000-2020, while green dots the conditions for 1970-1990. A shift to the left or upwards from green to red indicates a decrease of soil moisture and thus an elevated drought condition.



Climate Modelling Techniques

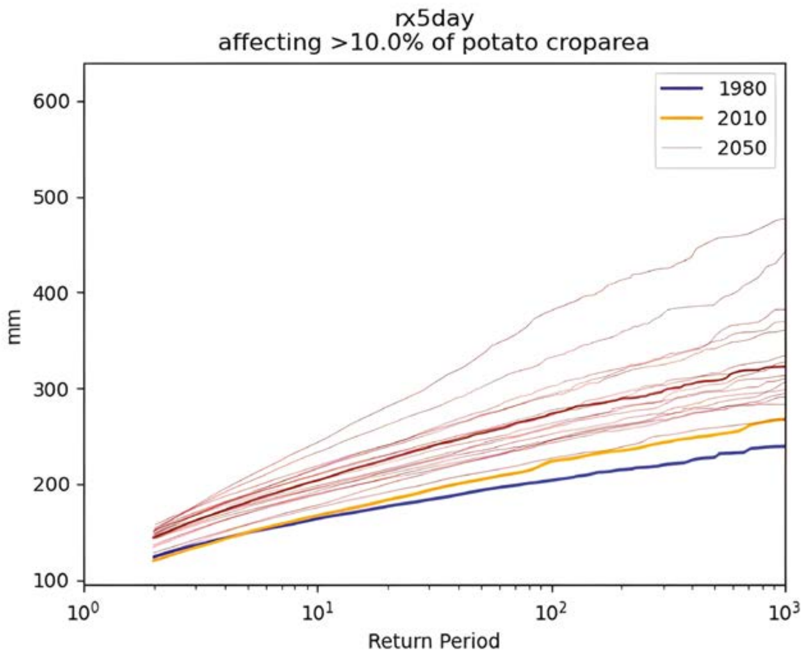
For calculating the CMIP6 bias-corrected ensemble, we used a total of 16 climate experiments for SSP2-4.5 and SSP5-8.5. These included:

CanESM5, CMCC-CM2-SR5, CMCC-ESM2, EC-Earth3, EC-Earth3-Veg-LR, FGOALS-g3, GFDL-CM4, GFDL-ESM4, HadGEM3-GC31-LL, INM-CM4-8, INM-CM5-0, MIROC6, MIROC-ES2L, MPI-ESM1-2-LR, NorESM2-MM, UKESM1-0-LL.

From those 16 experiments, the ensemble mean has been used for the selected climate risk indicators. Each experiment covers both a historic remodelling from 1950-2014 and the SSP-dependent climate projections from 2015-2100. Data was sourced from the CIL Global Downscaled Projects for Climate Impact Research provided by the Climate Impact Lab. The fundamental parameters used include daily total precipitation, daily maximum temperature and daily minimum temperature. These models are provided at about 0.25x0.25° resolution on-and-offshore.

On average, standard deviation of climate indicators across different climate experiments is around +/- 13% with respect to the ensemble mean. Across all experiments and assessed climate variables, INM-CM5-0 provided the highest estimates in about 25% of all cases. On the other hand, MIROC-ES2L, CMCC-CM2-SL and UKESM1-0-LL provided the lowest estimates in 11-16% of all cases. On average, the lowest estimates were about 22% lower than the ensemble mean, while the highest estimates were about 27% higher. This indicates, that the spread of the climate variability is stronger for above-average experiments. *Figure 70* shows an example of the spread for precipitation for different climate experiments in comparison to historic baselines.

Figure 71: Return Period curves for extreme continuous precipitation (rx5day) in Italy for potatoes affecting at least 10% of Italy's crop area. Blue indicates the baseline for 1980 (1970-1990), yellow indicates the increase for 2010 (2000-2020) and red indicates the different climate experiments (thin lines) including their ensemble mean (thick line) for 2050 (2040-2060.



e. Results

Results have been computed for all 27 EU member states and various crop types which can be grouped into horticulture (e.g. apples, potatoes, cherries, etc.), viticulture (grapes) and cereals (e.g. wheat, barley, etc.). Perils have been assessed to cover late frost and low temperatures, high temperatures, drought and precipitation as potential negative impact on crops. As described above, results are not only computed for the average condition in a whole country, but rather by looking at every percentile of the available crop area. This for disaggregation, when there is always some place in a country affected by a peril, but not the whole country at once. For example, Figures 2-4 summarize the average annual occurrence of various perils affecting at least 5% of the total crop area. For smaller shares of the respective crop area, the peril's intensities increase, while for larger shares, the average intensity does decrease.

Following the probability assessment above, the average annual occurrence for different time windows can be shown. Here, we highlight the conditions around 1980 (1970-1990 average), 2010 (2000-2020 average) and the climate projection for 2050 (2040-2060 average). In case of soil moisture as an indicator of drought, there are no stable climate projections available. However, since various climate variables, especially those that are temperature-related, are close to a linear extrapolation of the already ongoing climate change of the last decades, a linear extrapolation of the change in average soil moisture from 1980 to 2010 can be used to provide a first-level indicator of the upcoming trend. However, the reduction in soil moisture is not only related to a changing climate but also due to the exploitation of groundwater resources. By focusing on the uppermost soil layer, meteorological drought conditions can be better captured as they are primarily affected by a reduction in long-term precipitation. In addition, it describes the immediate water availability of crops and reacts quickly to short-term climate variability.

With on-going climate change, there are also some general trends visible. For almost all crops, the amount of accumulated GDDs before the occurrence of the last frost, called 'late spring frost', is increasing except for viticulture. Here, further analysis is necessary due to contradicting results between historical observations and climate projects. However, this might be due to the fact that grapes are usually grown in the warmest regions with already rare frost conditions and with rising temperatures making also late spring frosts much less likely to occur. In France, at least, it is also because parts of the country have an increasing trend, yet other parts have a significantly downward trend.

In addition, the intensity of extreme precipitation (in this case, for rainfall over 5 days) does increase for almost all countries or remains stable for the others. Finally, for drought, average soil moisture has dropped almost everywhere except for Austria and Ireland.

On average for all countries, the amount of GDDs before the last frost has increased between 1980 and 2010 by about 20% and will increase to 35% by 2050 under SSP5-8.5 for horticulture. Similarly, average annual extreme rainfall increased by about 3% for 2010 and will reach up to 15% on average by 2050. Regarding soil moisture, EU-27 have lost about 10% of soil moisture since 1980.

Statistical Techniques and Output Applications

The dataset spanned approximately 40 years, with a focus on modern data post-2000 for smaller datasets. Key techniques used in the analysis included:

- Peaks over Threshold (PoT):
  - PoT was employed to isolate extreme agricultural losses for each hazard.
  - Loss thresholds were defined based on historical data to identify significant events.
  - Generalised Pareto Distributions (GPDs):
  - GPDs were used to extrapolate losses for longer return periods, allowing PML curves to extend out to 200 years.
  - Parameters for GPDs were fitted based on the scale and frequency of past extreme events.
- Synthetic Dataset Generation:
  - A synthetic 10000-year dataset was created to estimate potential maximum exposure, accounting for crop types and production cycles.
  - For example, hail impacts were tied to seasonal cycles of horticulture and viticulture, while drought effects were focused on cereal production and, to a lesser extent, tree crops.
  - For drought, in addition to the soil moisture a PDSI (Palmer Drought Severity Index) and SPEI stochastic event set has been produced for Europe using the OWDA database, and ERA5 reanalysis respectively, in order to determine the correlations between the individual country models to account for cross-country drought events. In future work this could also refine the drought modelling.
  - For hail, a synthetic dataset was created using a different methodology. Probabilistic maps of hail intensities and frequencies from a combined KIT and ESSL dataset. Through combining this with known footprints from representative hail event copulas via Schmidberger (2018), a determination of the frequency and severity of possible events in a year was derived.

For countries with sufficient historical data, AAL and PML curves were generated directly using the stochastic runs combined with the empirical yield loss results. The fitting process ensured that the curves reflected observed loss distributions and historical trends.

Historic matching was undertaken with the stochastic runs in order to produce the 2025 and 2050 baseline. This uses the representative years and climate parameters (such as soil moisture, SPI, PDSI, TnGDD and Rx) in order to give a representative proxy for the events, on the basis of past event damages and adjustments. On the basis of the empirical PML curves, matching was done to representative event years to create the PML curve for each peril. The hail modelling was completed using a hybrid version of a climate signature out to 2050 through the Ar-ChaMO model to adjust the frequency of the event set with checks against RAIN. In this way on the basis of the return period change of the events in the stochastic set, the 2050 damages were derived.

To examine the relationship of the individual rain, hail, frost and drought damages, correlation matrices were developed to quantify relationships between countries. These matrices used historical events and patterns to estimate regional interdependencies, enabling EU-wide impact assessments (on the basis of the empirical curves). For example, shared drought years between countries provided insights into cross-border risk correlations and combined losses.

f. Linking the year yield loss results per peril with the need for yield loss bins associated with each hazard.

From the scenario year results, a mixture of small event and large event damages are seen. Depending on the peril however, the distribution can be comparatively different.

One important consideration is how finely we disaggregate exposure by crop when creating the yield loss bins. In our probabilistic framework, we kept wheat, barley, and maize separate to preserve their different loss contributions as part of cereals. However, for the final protection gap analysis, we often needed an aggregate result (like total loss from drought across all crops). To get this, we combined the losses of the modelled crops and also had to make an assumption for other crops not explicitly modelled. We scaled up the losses of our representative crops to approximate the whole agricultural sector. For instance, winter wheat and winter barley together might cover a large share of arable land. Crops not modelled (say maize, rapeseed, vegetables, etc.) were implicitly assumed to either have similar proportional losses under a given peril or to be of lesser significance in that peril. This is admittedly a simplification and an area where data limitations forced a trade-off – ideally, each crop type's vulnerability would be separately modelled and summed, but time constraints required focusing on the biggest contributors. As a result, when we present expected losses by peril in the final analysis, they represent an aggregate across crops.

We did not break down the expected loss or protection gap by individual crop in the final results, primarily because developing full distributions and insurance calculations for every crop exceeded the scope and timeline of the project. Instead, we prioritised resolving the losses by peril, which is more directly useful for understanding which hazards drive the gap and is supported by the fact that the major crops we modelled cover a large portion of the risk. This decision (peril-wise breakdown but not crop-wise) is a conscious compromise due to data and time limitations: While it would be ideal to know, say, how much of the gap is from wheat versus maize, it was more critical to distinguish drought-driven gap versus hail-driven gap. The rationale is that risk mitigation strategies (e.g. insurance product design or public policy) often target perils rather than individual crops, especially in a multi-crop system.

To derive probabilistic yield loss distributions for each agricultural peril (such as drought, hail, frost, and excess rainfall), a mixed beta distribution approach was applied. This method aimed to convert national-level expected yield losses into a series of plausible loss bins, expressed in 10% increments (e.g. 0–10%, 10–20%, ..., 90–100%), suitable for protection gap and risk-layer modelling.

The foundation of this methodology is the beta distribution, which is flexible and defined over the interval [0,1], corresponding naturally to percentage-based losses from 0% to 100%. Rather than fitting a single beta distribution per peril and country, we constructed a weighted mixture of three generic beta components to simulate different shapes of potential loss profiles. These components represent typical small-loss, moderate-loss, and extreme-loss behaviours. Mathematically, the combined distribution is defined as:

$$\mathbf{P(x) = w_1 \times f_1(x) + w_2 \times f_2(x) + w_3 \times f_3(x),}$$

where $\mathbf{f_1(x)}$, $\mathbf{f_2(x)}$, and $\mathbf{f_3(x)}$ are beta probability density functions with differing shape parameters, and $\mathbf{w_1 + w_2 + w_3}$ = 1 are their corresponding weights. The shape parameters were fixed generically to emulate commonly observed loss profiles, while the weights were varied by peril to reflect empirical knowledge and expert judgment. For example, drought and rainfall perils were given greater weight on the tail of the distribution to simulate a higher frequency of severe yield losses, whereas hail and frost were assigned a more balanced distribution reflecting their spatially constrained or seasonally intermittent nature.

Each generated beta distribution was evaluated over 1% resolution intervals (i.e. from 0% to 100% in 1% steps). The resulting density was normalised to sum to one and then scaled to match the known or modelled expected yield loss value, μ. This ensures that the distribution retains its shape while being consistent with the average loss. The scaling step is expressed as:

$$P\_scaled(x) = (P(x) / \Sigma P(x) \cdot \Delta x) \times \mu,$$

where $\Delta x = 0.01$ is the bin width. After scaling, the fine-resolution distribution was aggregated into 10 macro-bins of 10% each, with each bin B_k defined as:

$$B_k = \Sigma\_\{i=k\}^\wedge\{k+9\}\ P\_scaled(x_i), \text{ for } k = 0, 10, \ldots, 90.$$

These ten bins together form a discrete, interpretable representation of the yield loss distribution that allows direct comparison with protection layers (e.g. deductibles, insurance ceilings) and loss-sharing mechanisms.

By avoiding reliance on purely empirical curve fitting, it accommodates data scarcity and shows the stylised nature of agricultural losses given the mixed yield losses across a country, rather than simply that every farm has 21% damage. The approach also produces results that sum correctly to the expected value, ensuring internal consistency. Although providing a strong foundation for estimating expected losses and analysing protection gaps in agricultural systems, this is one major source of uncertainty within the model, given the lack of full yield distribution data post-large events in Europe (modelling smaller yield damages is always very contentious).

For hail, which usually affects smaller areas, the national-level yield impact even for a rare hail-heavy year might be relatively low (e.g. a 1-in-50 year hail event might only reduce total wheat production by a few percent, since not all fields get hit, though locally losses could be 100%) – when looking at overall losses however, there is a more even distribution of losses where minor and moderate yield damages occur.

In the future, yield loss data by crop by peril could refine the model assumptions, but much more insurance/loss data is needed.

NB: Future losses and system adaptation

Future modelled agriculture losses presented in this report are one representation of the full spectrum of future trends possible, providing our best estimate. Future modelled agricultural losses are based on current exposures, meaning that no changes in crop production values, adaptive planting patterns or technologies are accounted for. In reality, agricultural systems are continually adapting to changing market, policy and climate conditions and driven by necessity, market forces and policy measures. For example, mechanisms such as the EU Adaptation Strategy, the Land Use, Land Use Change and Forestry Regulation and the EU CAP, aim to build resilience to climate risks through adaptation. The results presented in this report provide an assessment of potential losses should no adaptation take place, underscoring the importance of these measures.

NB: Scope of the study

Scenario Uncertainty - There is inherent uncertainty in hail projections due to variability in different research methodologies (ESSL vs. KIT-based approaches) and difficulty simply in the collection of hail sizes and detection at an EU scale.

Data limitations - Some regions (i.e. Belgium, Ireland, Denmark) have sparse insurance data, which may impact national-level loss estimates. Historical yield loss estimates rely on yield-based proxies, which may not fully capture extreme loss years. In addition, extrapolating the past 100 years for only 40-50 years of data makes it difficult to predict the upper return period event damages.

Return Period and Exceedance Estimates - The stochastic modelling provides a single realisation of many possible future states, reinforcing the need for ongoing scenario refinement. Historical events may not necessarily match well to current climate conditions in a changing environment.

Future Research - Higher-resolution climate modelling and refined stochastic hail simulations are necessary for improved extreme event projections. In addition, frost, rainfall and drought would benefit from this as well. Further integration of soil degradation and biological hazard effects (i.e. mildew) will enhance accuracy for rain-induced losses. The role of insurance innovation (i.e. parametric products) should be explored in greater detail to assess mitigation strategies.

NB: Crop Types assessed within this study

Historic yield analysis and calculation of production statistics has been completed for all major arable and permanent crop types as per standard Eurostat agricultural product definitions. These include but are not limited to:

Barley, Cauliflower, Dessert Apples, Dessert Grapes, Dessert Pears, Durum Wheat, Fibre plants, Fodder maize, Fodder root crops, Grain maize, Hops, Lemons, Mandarins, Oats, Olive oil, Other cereals, Other citrus fruits, Other crop products, Other forage plants, Other fresh fruits, Other fresh vegetables, Other grapes, Other industrial crops, Other olives, Peaches, Potatoes, Protein crops, Quality wine, Rapeseed, Tobacco, Rice, Rye, Seeds, Soft wheat, Soya, Sugar beet, Sunflower, Sweet oranges, Tomatoes.

When estimating the potential climate impacts of extreme heat / drought, hail, frost and excess rain on crop yields, the occurrence of poor climate conditions in relation to the state of the growth cycle of each crop is important to consider.

For simplicity of modelling, growing seasons were defined for representative proxy crops; for example, maize, barley and wheat were taken as proxies for groups of cereal crops, potatoes and apples as proxies for groups of different horticulture crops, and grapes as a proxy for viticulture. Using these proxies, all crops are then included in the yield loss modelling under future climate scenarios.

NB: Livestock Climate Risk Estimates

- This report focuses on crop losses but also provides high level livestock estimates for guidance. Almost 50% of EU agricultural production consists of livestock (including meat and dairy production).
- Livestock yield is directly affected by climate due to the impact of drought and heat on pastures and animal health. Livestock is also affected by secondary impacts e.g. by pests and diseases.
- Detailed analysis in this report focusses on the climate impacts to crop production only and unless otherwise indicated results relate to crop production losses.
- However, it is possible to derive high-level livestock risk estimates based on the observed patterns of losses from previous events and inputting the expected losses under current and future climate conditions. High level insights also include the losses associated with product transformation services (e.g. food processing) resulting from production losses, though again these are indicated clearly when included in high level results.
- To support a more complete picture of EU agriculture climate risks we have therefore included these high-level figures as indicative estimates of livestock and overall agricultural risks.
- Impacts to agricultural production beyond crops that are considered in this analysis include:
  - **Livestock Annual Average Losses** - based on empirical analysis of the impacts of weather events on livestock production (excl. disease);
  - **Livestock Disease Annual Average Losses** – based on limited empirical estimates of disease induced AAL from some EU member states;
  - **Transformation and Services factor** – a factor applied to account for the lost value from the conversion of crop and livestock products into other outputs.

Methodology for quality assurance

While a fully quantitative validation of forward-looking risk estimates is challenging, we took several steps to validate and sanity-check the model outputs qualitatively and quantitatively where possible.

Data Collection & Standardisation - Agricultural damage, insurance, and yield data were sourced from multiple empirical databases, including EUROSTAT, FADN, CATDAT and insurance industry datasets, then homogenised within the datasets.

Historical yield data was validated against agricultural ministry reports and cooperative data, as well as reported yield losses from reinsurers such as CCR. This added confidence in the results.

Disparate datasets across Member States were homogenised for consistency, including characterisation into five tabs. These were checked by multiple members of the team to ensure consistency and accuracy.

EU standard codes were used for the crops, livestock and services to ensure the sectors and crop types were correctly characterised under EUROSTAT definitions.

The climate runs for ssp245 and ssp585 for different crop types, global bias-corrected downscaled runs used an ensemble of standard CMIP6 models to ensure the climate models were consistent.

Extensive data checks on historic yield damage events and protection gaps were carried out by multiple teams.

- As part of the yield loss statistics and PML curves, historical loss events were benchmarked to check accuracy. We compared model-generated loss scenarios against known historical agricultural disaster years as a final sense check. For instance, 2018 was a severe drought year in northern Europe and our drought model for wheat and pasture produced high-end loss scenarios (20-30% yield losses in affected countries) in line with the observed impacts of 2018. Similarly, a notorious late frost in 2017 devastated fruit crops in central Europe – our frost scenarios for cereals showed relatively modest losses (since cereals are less vulnerable at that stage), which is consistent with actual outcomes (the impact was worse for specialty crops than for the major field crops we modelled). These comparisons give confidence that the model's severity estimates are realistic.
- External Studies - We referenced findings from independent studies (mainly insurance and government) to compare our results. These also show drought as the largest contributor to expected loss, followed by hail, then excess rain and finally frost. Such alignment with external data indicates the relative scale between perils is captured reasonably.
- We performed sensitivity tests on key parameters to check for robustness. Adjusting the baseline yield window (5-year vs 10-year) did not drastically change the total average losses, suggesting our approach isn't overly sensitive to that assumption. We also tried alternate bin definitions to see if the gap estimate swings wildly. It remained fairly stable so the binning resolution is adequate. Additionally, we examined whether using a normal (bell-curve) distribution instead of beta for some perils would change the results. Beta was a better fit for the skewed nature of losses (many small losses, few large), so this was retained. These checks improved confidence that the methodology was not producing anomalous results due to arbitrary choices.
- The modelling integrates stochastic simulations and empirical-hybrid PML curves, developed using historical agricultural losses and climate projections. Probabilistic event-based modelling methods were applied across all perils (drought, frost, hail, rain/flooding), using datasets built via standard climate parameters and using the best methods available in EU research on these hazards.

Hail modelling validated through Ar-ChaMo trends (ESSL & KIT methodologies) checked against other results such as PartnerRe.

Drought model validated via stochastic set with SPEI and PSDI-based year matching compared with country drought event data to check frequencies of the soil moisture vs. years with drought damage.

Frost model calibrated against growing degree days (GDDs) for key crops. The results were checked against the worst frost years such as 2017 and 2021 to check consistency.

Rain/flood modelling checked against Rx5day indices and historical data as well as the key years as per other climate perils.

An extensive validation was made by Risklayer,[287] using historical events to ensure the results were consistent with past large events. The parameters in the model match peer-reviewed papers.

Comparison was also made to external studies, and similar studies where appropriate with findings benchmarked against JRC PESETA IV & V results for consistency. Key trends, particularly drought and cereal losses in southern and eastern Europe, align with established EU-wide agricultural projections.

Statistical Robustness Checks were made for the PML curves tested with Generalised Pareto Distributions (GPDs) and Peaks-over-Threshold (PoT) methods ensuring the datasets were statistically reasonable with a synthetic dataset of 1 000-year event realisations used to verify return period exceedances.

Cross-border peril correlations incorporated historical empirical data and climate model outputs.

Methodology for Country Protection Gaps

Aim and overarching approach of protection gap methodology

In this report we refer to the insurance protection gap as the difference between the expected agricultural crop losses and the prearranged compensation expected to available to agricultural producers. In this report, the agricultural crop insurance protection gaps for each Member State are estimated for each of the primary perils for EU agricultural losses (drought, frost, hail, rain) and for a number of return periods (1-in-5-year and 1-in-50-year). These combine risk modelling results of the expected crop losses from these perils with simple models of national agricultural risk management systems based on a literature review. The analysis is based on:

a. Public information available including through industry reports, news articles, stakeholder engagement and government documents. A structured summary of national agricultural risk management systems was compiled using key market data and descriptions of key features and dynamics. This includes an assessment of system configuration to address different perils, crops and layers of risk, the role of private, national and EU institutions and evidence of insurance performance in historic events.

b. The research for part a) enabled us to construct models of national insurance systems to illustrate how the impacts of different types of loss events (1-in-5-year and 1-in-50-year) of different perils and crops could be allocated across national agricultural risk management systems.

c. We apply the EU agricultural climate risk modelling results described above to these national insurance system models to produce a net estimate distributing losses to farmers, insurers and governments. This provides an estimate of the proportion of current losses to agricultural crop production that would theoretically be covered by prearranged compensation systems according to our modelling and an estimate of the proportion of overall losses falling to farmers. Risk modelling of the future climate is used to produce estimates of how projected future patterns of losses could affect the allocation of losses falling across the system. This provides an indicative representation of the future based on a single climate risk perspective and does not provide a likelihood of future occurrence.

287 Risklayer GmbH - Global Catastrophe Risk Analytics Management GmbH (n.b.).

d. This approach enables high level estimates of the distribution of possible losses across participants in the agricultural risk management system (farmers, insurers and government) for the four perils (drought, frost, hail, rain) to support high level policy making at the EU level. We prioritised conducting this analysis to be replicable across Member States so it is based on (a) an assessment of climate change effects for the aforementioned perils on the expected yield of crop production that is consistent across all Member States (b) a high level review of potential risk layering in prearranged risk financing systems that is consistent across Member States. This is an indicative assessment which has applied generalised and partial data where available with further work required to develop more granular assessments.

To construct theoretical models of risk layering within national prearranged agricultural risk financing systems a review of literature including reports, news articles and acts of government was used to inform assumptions on three primary metrics for each Member State: (1) the penetration rate of crop insurance coverage (2) the average deductible on crop insurance policies for specific perils (3) yield losses triggering prearranged public compensation and the proportion of losses covered. In the absence of complete and consistent insurance data across Member States (including premium volume, claims payments) which could have been used to assess national agricultural protection gaps, this approach enabled us to produce indicative results with a consistent methodology across the example Member States.

Coverage and deductible assumptions are constant for both present day and future climate change protection gap estimates. Policy conditions are likely to change as climate impacts set in and as a result of other external market factors. However, the purpose of this analysis is to demonstrate how losses would be distributed among market participants if systems were to remain structured in the same way, indicating potential areas within current systems where stresses are likely to arise without systemic adaptation.

Yield loss estimates

The protection gap estimates are based on area yield loss modelling results from the current and future climate loss modelling as described prior. Our area yield loss analysis produces estimates of the distribution of probable maximum crop losses (in EUR) for given return periods for each primary peril (drought, frost, hail, rain) that are expected in agricultural areas experiencing yield losses of 0-10%, 10-20%, 20-30%, 30-40%, 40-50%, 50-60%, 60-70%, 70-80%, 80-90% and 90-100%. Understanding the distribution of expected losses across these yield bins allows us to estimate the potential total cost of losses across entire Member States by summing these, as well as the potential distribution of yield losses across agricultural areas that contribute to the overall loss within Member States.

Risk Layering

This methodology relies on implied risk layers within Member State agricultural risk management systems. These 'risk layers' delineate 'responsibility' for portions of losses (in terms of % yield damage) for participants within the system. This is mediated through legal and social contracts including insurance and state commitments that often define responsibility based on factors such as % yield lost. The terms 'farmers', 'insurers' and 'government' refer in aggregate to participants in the system responsible for layers of risk pre-defined by the specific conditions of the market.

'Farmers' refers to those financially responsible for losses in agricultural crop production that do not fall to insurers or the state through prearranged risk financing. Even though modelled losses not expected to be compensated by insurers or the state through prearranged financing are assumed to fall to this category there is no consideration of individual farmers, farm size or individual farm insurance coverage. The same concept applies to 'insurers' and 'government' responsible for compensating predefined portions of losses in each country.

This methodology has been developed in response to the lack of consistent, disaggregated insurance data across Member States. In reality potential losses could be distributed very unevenly to farmers, individual insurers or national and subnational government organisations. Indeed some losses are passed onto other agents within the wider economic system such as the state through ad-hoc funds, or even end consumers through increased prices.

Insurance penetration

Insurance penetration is the proportion of crop area insured against a specific peril. Low insurance penetration rates precludes many farms from receiving insurance payouts, leaving a high proportion of potential losses to farmers. Losses on the proportion of agricultural area that is uninsured (according to penetration rate estimates from the literature review) are assumed to fall on farmers. In reality, uninsured farmers may often receive ad-hoc State aid, however this is not reflected in our protection gap estimates as it is unplanned. This also assumes that insurance coverage is the same across each Member State when in reality areas more at risk of losses may see more coverage.

As our yield loss modelling disaggregates losses by peril but not by crop coverage it is assumed that penetration rates are constant across crops within Member States. In many countries precise insurance penetration rates for crop insurance coverage are not available and we have made best-effort estimates based on various sources.

Events, Losses and Risk Allocation

Climate losses have varied impacts on different crops: some will have low yield losses and others will be higher depending on their specific vulnerabilities. Yield based impact assessments are required because in most insurance and prearranged public compensation systems compensation for farmers depends on predefined thresholds (deductibles). From our research across Member States this typically sits at around 20% (see Matrix) but can vary.

Through the literature review, we collated estimates at Member State level of the yield loss bands in % where insurers and prearranged public schemes provide compensation and the corresponding compensation rate (e.g. 50% of euro losses from over 20% yield loss).

We take the assumed deductible and threshold, or attachment point, for prearranged public compensation and use this to distribute modelled losses between market participants according to the risk layering methodology. For the proportion of losses expected to be insured (according to coverage estimates) the proportion of expected current and future losses to be borne by farmers through the retained risk layer is assumed to equal the sum of modelled yield losses falling within yield loss bands below the deductible. Yield losses above the deductible are assumed to fall to insurers or other prearranged public compensation schemes.

Although effects on individual crop types are considered, our modelling breaks down losses by peril rather than crop. So for each peril a common deductible is used to estimate the proportion of losses which are retained vs compensated across crops.

Prearranged public financing and ad-hoc payments

Prearranged public risk financing triggered by yield losses over defined thresholds is accounted for in the methodology. Depending on the conditions in the prearranged public financing framework used, a proportion of losses falling within predetermined yield bins will fall to the State.

This analysis does not account for ad-hoc State aid payments as these do not constitute prearranged risk financing or have a predictable or structural role in agricultural risk layering and protection. Uncertain and unplanned *ad hoc* support is challenging for farmers, insurance markets and Member States. Their presence and expectation can introduce inefficiencies and moral hazard, disincentivising insurance uptake.

We estimate the proportion of expected current and future losses from each peril for the defined agricultural crops that are be borne by i) farmers through either uninsured losses or retained losses beneath the expected deducible of their insurance protection, ii) insurers through payouts and iii) Member States through prearranged risk finance.

Protection gap estimates

Based on estimates for coverage, deductible estimates and conditions of post-disaster public compensation schemes, overall expected crop losses from each of the four perils for given return periods can be allocated to the three groups (farmers, insurers, government) in each Member State.

Uninsured farmers carry 100% of their losses while those insured are assumed to bear the costs associated with yield losses below the assumed deductible threshold. So losses falling on farmers equal the sum of yield losses across all yield bins multiplied by 1- penetration rate, plus the sum of yield losses within yield bins below the deductible, multiplied by the penetration rate.

Within insured agricultural areas, insurers are assumed to provide compensation where yields exceed predefined deductible thresholds and to the point where prearranged public compensation steps in. Therefore, losses falling to insurers equal the sum of yield losses falling within yield bins above the deductible and below the level of state intervention, multiplied by the penetration rate.

In some Member States, insurers and government may both compensate portions of losses within given yield loss bins (e.g. France, see Figure 50). These examples are incorporated into the calculations on a case-by-case basis.

The table below illustrates how expected losses within each yield bin (where $l_{x\text{-}y}$ are the expected losses within the yield bin for yield losses between x & y for a given peril and return period loss) are allocated to farmers (blue) and insurers (orange) to produce high level estimates of the distribution of agricultural crop losses across market participants under current conditions and given the assumptions outlined above.

Yield Bin (%)	Comment	% total loss in areas experiencing yield losses within the yield bin	
		Insured (loss * penetration rate)	Uninsured (loss * (1-penetration rate)
90-100	Compensated by insurance where purchased	$p \times l_{90-100}$	$(1-p) \times l_{90-100}$
80-90	Compensated by insurance where purchased	$p \times l_{80-90}$	$(1-p) \times l_{80-90}$
70-80	Compensated by insurance where purchased	$p \times l_{70-80}$	$(1-p) \times l_{70-80}$
60-70	Compensated by insurance where purchased	$p \times l_{60-70}$	$(1-p) \times l_{60-70}$
50-60	Compensated by insurance where purchased	$p \times l_{50-60}$	$(1-p) \times l_{50-60}$
40-50	Compensated by insurance where purchased	$p \times l_{40-50}$	$(1-p) \times l_{40-50}$
30-40	Compensated by insurance where purchased	$p \times l_{30-40}$	$(1-p) \times l_{30-40}$
20-30	Retained within farmers deductible	$p \times l_{20-30}$	$(1-p) \times l_{20-30}$
10-20	Retained within farmers deductible	$p \times l_{10-20}$	$(1-p) \times l_{10-20}$
0-10	Retained within farmers deductible	$p \times l_{0-10}$	$(1-p) \times l_{0-10}$

Interviews

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