

# Risk Management and Agricultural Insurance Schemes in Europe

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Risk Management  
and Agricultural Insurance Schemes in Europe

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## Contents

FOREWORD	5
ACKNOWLEDGEMENTS	5
1. Abstract	6
2. Introduction	6
3. Policy framework	7
<b>3.1 WTO agreements</b>	<b>7</b>
<b>3.2 The concept of crisis and disaster – Regulations on state aid</b>	<b>8</b>
4. Crop risk management systems	9
<b>4.1 Main tools for risk management in agriculture</b>	<b>9</b>
4.1.1. On-farm strategies	9
4.1.2. Risk sharing strategies	9
<b>4.2 Risk management systems outside the EU</b>	<b>10</b>
<b>4.3 Risk management systems in the EU</b>	<b>12</b>
4.3.1. Funds and ad hoc aids	12
4.3.2. Insurance	12
4.3.3. Risk management for livestock	17
<b>4.4 Discussion on the possible implementation of European risk management products</b>	<b>18</b>
5. Technical feasibility of a European index for risk management	19
<b>5.1 Introduction</b>	<b>19</b>
<b>5.2 Discussion on feasibility of index insurance in the EU</b>	<b>19</b>
<b>5.3 Regional (FADN region) yield index</b>	<b>20</b>
<b>5.4 Meteorological parameters or weather indices</b>	<b>21</b>
<b>5.5 Parameters computed from an agrometeorological model</b>	<b>21</b>
<b>5.6 Parameters from satellite images</b>	<b>22</b>
<b>5.7 Cross-validation of indirect index insurance with FADN data</b>	<b>22</b>
6. Conclusions	23
7. References	25
8. Glossary	27
9. Acronyms	28

## Tables

<b>Table 1. Ad hoc and funds payments in the last years (data from fact sheets)</b>	<b>13</b>
<b>Table 2. Agricultural insurance in Europe</b>	<b>15</b>

## Figures

<b>Figure 1. Main agricultural insurance systems in the EU</b>	<b>14</b>
<b>Figure 2. Premium rates for RYI for wheat (trigger 30% and 15%)</b>	<b>20</b>
<b>Figure 3. Some clusters of NUTS-2 regions to estimate the explanatory power of agrometeorological indices on the yield of main crops</b>	<b>21</b>
<b>Figure 4. Wheat production risk reduction and relative risk reduction from area yield insurance</b>	<b>22</b>

## FOREWORD

This report is a summary review of the ‘Agricultural Insurances Schemes’ project, that has been published in two JRC Scientific and Technical Reports (*Agricultural Insurances Schemes I and II*) (Bielza et al. 2008a, 2008b) and several papers (Bielza et al. 2007a, 2007b; Bielza et al. 2008c; Bielza et al. 2009). These studies have been conducted by the Institute for the Protection and Security of the Citizen (IPSC), Monitoring Agricultural ResourceS (MARS) Unit of the Joint Research Centre (JRC) of the European Commission in the framework of the administrative arrangements Nos AGRI-2005-0321 and AGRI-2007-0343 with the Directorate-General for Agriculture and Rural Development (DG AGRI). This project was requested by the European Parliament in the context of the ongoing discussion on the Commission communication on risks and crisis management in agriculture (COM (2005) 74 final) and the Council conclusions of 17 December 2003 on risk management in agriculture.

Most information in the first report comes from fact sheets collected from experts or consultants in the different countries and from data provided by the European Committee of Insurers (CEA). Most details in the analysis are omitted but a summarised glossary with a few insurance keywords is included. The reader wishing to have more extended information can refer to the full reports.

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## 1. Abstract

In recent years, the European Union (EU) has been considering a possible integration of risk management in the Common Agricultural Policy (CAP) analysing risk and crisis management strategies to provide an improved response to crises in the agricultural sector. The report reviews the agricultural risk management systems in the EU-27 (candidate countries Turkey and Croatia are also analysed) with a special focus on types of agricultural insurance. The study contains data and information collected by experts or consultants from the different European countries. Most of this material has not been published before.

Governments have an important role in helping farmers to face disasters. Usually they provide *ex post* aid and sometimes they offer or subsidise insurances. *Ex post* aid is significant in Member States (MS); it is provided on an ad hoc basis, or through compensation schemes or funds partially financed by the agricultural sector.

Several types of agricultural insurance systems exist in each country and key figures describe their technicalities, such as re-insurance, triggers and deductibles. Agricultural insurances are fostered in a number of countries. Government's involvement is crucial for insurance development: while private companies only insure against hail

and fire, insurance against agricultural systemic risks becomes affordable for farmers only with government subsidies and/or public re-insurance.

The study evaluates the feasibility of index insurances for the EU and makes a cross-validation based on the yield loss risk calculated from Farm Accountancy Data Network (FADN) data. Premiums have been estimated for a Regional Yield Insurance (RYI) for FADN regions and the major arable crops. Additionally, some meteorological, agrometeorological and Normalised Difference Vegetation Index (NDVI) indicators were tested. From the statistical analysis, the indicators do not explain yields optimally. The cross-validation of RYI consisted in the calculation of farm risk with and without insurance. Results show that the risk reduction capacity of the yield area index for the case analysed is not very high, but that in some regions the risk can be reduced up to 68%. The risk reduction capacity of other indices is expected to be lower than the yield area index.

Finally, the study shows that index products' efficiency is relatively low at farm level due to the European heterogeneity of climates and geography, and to the large geographical scale of the study. So, index products could be more efficient for re-insurance that works at an aggregated level.

## 2. Introduction

Agricultural producers face a series of risks affecting the income and welfare of their households. The economic situation of farms can be subject to strong variability due to several reasons, set out below.

- Policy reforms, marked by trade agreements and market liberalisation and the consequent reduction of prices paid to farmers.
- An unbalanced relationship amongst retailers, who are generally well organised and able to apply strong pressure on prices and farmers.
- Sanitary measures and risk of animal diseases.
- Climate change: There is a general perception that the frequency and intensity of extreme meteorological events is growing (IPCC, 2007; Alexander et al. 2006). Climatic risks are more

important for crops and sanitary risks are more important for livestock, but neither of them is exclusive: pests can have a considerable impact on crops and bad climatic conditions can badly damage livestock farming by affecting pastures or forage availability.

Consequently, the income stability of agricultural stakeholders can be also affected.

In recent years, the EU has been considering a possible integration of risk management in the Common Agricultural Policy (CAP) and is analysing risk and crisis management strategies to provide an improved response to crises in the agricultural sector. In the context of the ongoing discussion on the Commission communication on risks and crisis management in agriculture (COM (2005) 74 final) and the Council conclusions of 17 December 2003 on risk management in agriculture,

the European Parliament requested a study on Agricultural Insurance schemes. In fact, this report is a summary review of the 'Agricultural Insurances Schemes' project. It consists of two studies <sup>(1)</sup>, *Agricultural Insurances Schemes I* and *II* (Bielza et al. 2008a, 2008b), undertaken by the Institute for the Protection and Security of the Citizen (IPSC) of the Agriculture Unit under the Joint Research Centre (JRC) of the European Commission in the framework of the administrative arrangements Nos AGRI-2005-0321 and AGRI-2007-0343 with Directorate-General for Agriculture and Rural Development (DG AGRI).

Simultaneously with this project, a consortium of European research centres, universities and others carried out another study on the topic of risk management, known as the 'Income Stabilisation' project. It was developed under the Sixth Framework Programme (FP6) and concluded in March 2008; it provided the Commission with a risk and risk perception analysis, as well as an economic analysis of different policy scenarios and risk management tools, including recommendations for the design and implementation of such instruments.

The *Agricultural Insurance Schemes I* report reviews agricultural risk management systems in the EU (candidate countries Turkey and Croatia are also analysed) with a special focus on types of agricultural insurance. The study contains a collection of data on the realities and modalities of agricultural insurance in Europe. This information mainly comes from fact sheets filled in by experts or consultants from different European countries. A fact sheet was sent to all national experts, requiring them to fill in a description of the risk management systems in their countries, of the calamity aid and regulations, and insurance products available, their technicalities, re-insurance systems and some data on insurance demand or market penetration. Most of these data were unpublished because there is no obligation for insurance companies to report to EU institutions or, in many cases, to national institutions. Unfortunately, data from some countries are still missing or incomplete. It is especially difficult to collect information from the private insurance companies when there are no public subsidies. For example, much information is missing from the Netherlands and from the French non-subsidised insurance products, while no information at all could be collected for Malta.

### 3. Policy framework

#### 3.1 WTO agreements

Public aid for agriculture has to comply with the World Trade Organization (WTO) agreements, which classify aid into three coloured boxes: Green, Blue and Amber. The Green Box defines other aid that does not distort trade. The Blue Box contains aid for goods that have a production limitation (e.g. milk in the EU). The Amber Box represents other support measures to agriculture. Aid in the Amber Box which exceed the '*de minimis*' limits (5% of agricultural production for developed countries and 10% for developing countries) are subject to reduction commitments.

The Uruguay Round Agreement defines the conditions under which aid for risk management could be placed in the Green Box, that is, not involving trade distortion and not subject to reduction commitments. They can be addressed to income losses or to production losses from natural disasters, as shown below.

- **Income insurance** and income safety nets. Aid is admitted when the 'income loss [...] exceeds 30 per cent of average gross income or the equivalent in net income terms [...] in the preceding three-year period or a three-year average based on the preceding five-year period, excluding the highest and the lowest entry. The amount of such payments shall compensate for less than 70 per cent of the producer's income loss in the year [...]'. Programmes based on farmers' income are not frequent. Canada noted one programme.
- Payments for relief from **natural disasters** (directly or by subsidies of crop insurance) also fall in the Green Box if there is a 'formal

<sup>1</sup> EUR 23392 EN-2008 EUR – Scientific and Technical Research series – ISSN 1018-5593. Available at <http://mars.jrc.ec.europa.eu/mars/Bulletins-Publications/Agricultural-Insurance-Schemes-I-JRC-Scientific-and-Technical-Report>, and <http://mars.jrc.ec.europa.eu/mars/Bulletins-Publications/Agricultural-Insurance-Schemes-II-JRC-Scientific-and-Technical-Report> online.

recognition by government authorities that a natural or like disaster [...] with a production loss which exceeds 30 per cent of the average of production in the preceding three-year period or a three-year average based on the preceding five-year period, excluding the highest and the lowest entry'. Agricultural insurances are mentioned, but mostly ad hoc payments are noted.

However, up to now most of the subsidies to crop insurances have been notified within the Amber Box. One of the main reasons is that they do not follow a formal recognition by government authorities of the natural disaster. Such recognition is not operational in the current insurance model managed by private companies. Other reasons often exist but do not apply to all types of insurance products (e.g. 30% threshold or being product-specific).

### 3.2 The concept of crisis and disaster – Regulations on state aid

The definitions of crisis and disaster that are used by international organisations (UN/ISDR, 2004; ECHO; EM-DAT) are usually rather generic. More precise definitions can be found in European national regulations relating to the authorisation of state aid in case of disaster or adverse climatic conditions. National experts provided information for this report on each MS' definitions for disasters and crises which are eligible for *ex post* aid, and also the definitions of insurable risks whenever they exist. Most of the definitions of being eligible for disaster or calamity require an official declaration of disaster.

The definitions of crisis and disaster eligible for public aid in EU MS have been compared with the 'Community guidelines for State aid in the agriculture sector 2000-06' (EC, 2000). Even if most EU MS followed the 2000 Guidelines to decide when aid can be bestowed, some heterogeneity was found and MS can be classified into four groups according to their observance of the guidelines: some of them incorporated or explicitly mentioned the guideline definitions in their legislation; others just assumed them without explicit mention; a third group had more restrictive definitions than those established in the guidelines, as it is the case for the calamity fund system in France; and last, some MS had less restrictive definitions than those in the guidelines.

These different MS' attitudes applied while the guidelines were only 'advisory'. New Commission guidelines (EC, 2006b) and a new regulation (EC, 2006a) on the application of Articles 87 and 88 of the Treaty were adopted in December 2006. The definitions assumed are strongly shaped by WTO agreements.

Regarding the inter-relationship of ad hoc aid and insurance, from 2010 onwards the new regulation partially sets the condition that State aid must buy some type of insurance. Before 2006, some countries were already forbidding State aid in the case of crisis or disaster if the risk could have been insured. This is the case for Austria, Greece, Italy, Portugal, Spain, Sweden and Turkey for subsidised insurable risks and for France under the condition that insurance had reached a significant diffusion level.

On 20 November 2008, the EU agriculture ministers reached a political agreement on the Health Check of the Common Agricultural Policy. The Health Check intends to modernise, simplify and streamline the CAP and remove restrictions on farmers, thus helping them to respond better to signals from the market and to face new challenges. Among a range of measures, the agreement converts market intervention into a genuine safety net, and increases assistance to sectors with special problems (so-called 'Article 68' measures). Currently, MS may retain, by sector, 10% of their national budget ceilings for direct payments for use for environmental measures or for improving the quality and marketing of products in that sector. This possibility will become more flexible. The money will no longer have to be used in the same sector; it may be used to help farmers producing milk, meat, rice, beef, goats and sheep in disadvantaged regions or vulnerable types of farming, and it may also be used to support risk management measures such as insurance schemes for natural disasters and mutual funds for animal diseases (Arts. 68 to 70 of CR, 2009); and countries operating the Single Area Payment Scheme (SAPS) system will become eligible for the scheme.

## 4. Crop risk management systems

### 4.1 Main tools for risk management in agriculture

Tools for risk management in agriculture are classified in two groups: strategies concerning **on-farm measures** and **risk sharing strategies**.

#### 4.1.1. On-farm strategies

Some examples of **on-farm strategies** follow.

- **Diversification:** Diversification of crops and/or livestock production implies that a favourable result in one enterprise may help to cope with a loss in another. Diversification thus reduces the overall risk. However, it is usually associated with a lower average income, because it is not only the most profitable enterprises that are undertaken and also because higher costs are often associated (additional equipment, forgone economies of scale, lack of managerial expertise, etc.). Often diversification is extended to off-farm activities.
- **Vertical integration:** A vertically integrated firm retains ownership control of a commodity across two or more levels of activity. Risk reduction is one of the reasons to vertically integrate them. It helps to reduce risks associated with a variation in quantity and quality of inputs (backward integration) or outputs (forward integration). Vertical integration is more common in the livestock sector (integration backward into feed manufacturing) or in the fresh vegetables sector (integration forward into sorting, assembling and packaging) (EC, 2001).
- **Stabilisation accounts:** Stabilisation accounts are a form of self-insurance. They consist of individual accounts into which farmers put an amount of money every year, which they can withdraw in a year of big losses. Stabilisation accounts can be based on yield, revenue or other indices.

#### 4.1.2. Risk sharing strategies

Some examples of **risk sharing strategies** include production contracts, marketing contracts, hedging on future markets (mainly for price risks) or participation in mutual funds and insurances (mainly for production risks). The strategies for production risks deserve special attention. They include a particular case, which consists in 'risk-sharing' with the government, that is, the calamity funds.

### Public funds or calamity funds

Public or calamity funds are regulated by the governments and provided on a regular (yearly) basis. Funds sometimes also receive contributions from the private sector, usually in the form of compulsory levies on production or levies on premiums. Aid is given under the declaration of catastrophes. The main advantage of the funds over ad hoc aid is that they avoid big distortions of the government budget.

### Mutual funds

According to the Commission communication (EC, 2005a) and the staff working document (EC, 2005b), mutual funds (or mutual stabilisation funds) represent a way of sharing risk among groups of producers who want to take their own responsibility for risk management. Mutual funds, established on private initiative, are set up mainly at a sector-specific level where producers share comparable risks, or take place at regional level. They can be regarded as a specific compensation scheme, although with a limited financial capacity. According to the working document on risk management tools (EC, 2001), in the case of a member incurring a loss, the loss will be fully or partially compensated through the collected money already available in the fund according to predefined rules (often with an additional collection from participants). Mutual stabilisation funds are often faced with the problem of limited resources, especially in the funds' early years.

The advantage of regionally organised mutual funds is that farmers know each other, thus reducing the problems related with moral hazard and adverse selection. The disadvantage of regionally organised mutual funds is the danger that many or even all farmers incur losses at the same time. For a farmer, this could mean that he or she incurs losses and has to contribute to the fund to cover other farmers' losses at the same time. Solutions for this problem are re-insurance or cooperation with mutual schemes in other regions which would cover a share of the loss.

However, as the CEA's position paper (CEA, 2005b) states, in the EC definition, the legal nature of these institutions is not clear. They could refer to guarantee funds, solidarity funds, or even to insurance mutuals. In fact, the working document (EC, 2001) identifies mutual funds with mutual insurance schemes, and many mutual insurance companies have similar characteristics to those of the mutual funds described above.

**Mutual insurance** schemes are a type of insurance. Mutual insurance companies, also called insurance mutuals, are insurance companies totally or at least partially owned by the participants. Insurance mutuals share with mutual funds the underlying principles of mutuals: a non-profit nature, cooperation and self-help. As non-profit companies, insurance mutuals have no shares or shareholders, so they are not on the stock market. Also, in contrast to insurance share or stock companies, besides the supervisory board they also have a delegate committee representing member farmers.

The key difference between a mutual fund and mutual insurance could be that mutual funds form a private agreement between the parties in which there is no legal title of compensation. Instead, when there is a legal title of compensation offered by some entity, then we can speak about mutual insurance and this entity has to comply with the legal requirements of insurance. Besides, the premiums are calculated on an actuarial basis, while provisions to a mutual fund are often a fixed amount independent of the risk. Re-insurance would be associated to mutual insurance and the existence of supplementations from the participants would be always associated to mutual funds.

## Insurance

**Insurance** is probably the best-known risk pooling tool. In order for a risk to be insurable, two basic requirements have to be met among others: managing the adverse effects of ‘asymmetric information’ and overcoming the implications of ‘systemic risks’ (a lot of people suffer a loss at the same time). Natural disasters or epizootic diseases cause special problems for insurance.

If re-insurance or state guarantees are not available, the nature of the systemic risks makes it necessary for an insurance company to charge very high premiums which can be unaffordable for many farmers, and to build up substantial capital reserves. This means that comprehensive agricultural insurances schemes need strong support from the public sector. On the other hand, if governments provide ad hoc disaster payments, it stifles the development of insurance products.

The characteristics of specific agricultural insurances are basically different in the crop sector and in the livestock sector. Livestock insurance covers mainly non-epidemic diseases and accidents. The most widely extended crop insurance is hail insur-

ance, which often includes other scattered risks such as fire (**single risk insurance**). Some kind of insurance policies cover also the risk of frost or a limited number of meteorological events. These are known as **combined risk insurance**.

We call ‘**yield insurance**’ the type of policy that covers yield losses for a given crop due to any meteorological event. The meteorological origin of the damage has to be identifiable to avoid moral hazard and adverse selection. In general, all the fields of a farm with the same crop have to be insured. Use of the term ‘multi-risk’ or ‘multi-peril crop insurance (MPCI)’ is avoided here because it is applied to both combined insurances and to yield insurances, depending on the circumstances.

**Whole-farm yield insurance** refers to all the crops produced by the farm. A yield reduction in one crop will not be compensated by the insurer if the global production reduction of the farm does not reach the trigger.

**Revenue insurance** combines yield and price insurance. The farmer is paid if the total value of his production if it falls below a threshold. **Income insurance** takes also into account the costs of production; it is only applied in US.

All the former types of insurance are based on the results of the individual farms, and losses are adjusted measured on the field. However, **index insurances** are based on a common index for an area. In **area-yield insurance**, the compensation paid to the farmer (and the trigger) depend on the statistical yield for the year in a predefined area, usually an administrative unit. **Area-revenue insurance** is based on the area yield multiplied by the area price. If the average yield/revenue in that area is below a certain threshold, all the farmers in the area insured for that crop are compensated. **Indirect-index insurance** does not refer to the average yield in an area but to a meteorological indicator or satellite images. Weather derivatives can be included in this category of insurances.

## 4.2 Risk management systems outside the EU

Risk management tools such as insurances and futures markets are well developed in North America. In the US there is no risk-specific insurance, but a yield insurance called multi-peril insurance, which covers most risks. It ranges from basic or catastrophic coverage (CAT) which guarantees

50% of the average yield of the farm, to 80% or 100%. Livestock insurance is not very well developed. The US and Canada have also developed revenue and income insurances.

In the US, both revenue and income insurance exist. Approximately 73% of the premiums come from revenue insurances products that include the following: area index revenue insurance, livestock prices insurance, livestock gross margin insurance, and whole-farm income insurance. The three standard revenue insurance products are *Crop Revenue Coverage* (CRC), *Revenue Assurance* (RA) and *Income Protection* (IP). The most popular is CRC, which offers the possibility to get a higher price if the market price increases. These products apply to the main field crops: corn, soybeans, wheat, rice, cotton, etc. *Livestock Risk Protection* (LRP) covers declining prices for swine, feeder cattle and fed cattle. *Livestock Gross Margin* (LGM) protects the gross margin between the value of insured hogs and the cost of feed inputs (corn and soybean meal). Reference prices come from the futures market. They protect against price oscillation within the year. The whole-farm income insurance, Adjusted Gross Revenue (AGR), uses a grower's history of tax information to provide a level of guaranteed revenue. It covers both crops and livestock if livestock gives less than 35% of the total income. In AGR-Lite, available in limited areas and similar to AGR, producers are eligible regardless of the percentage of their income derived from animal products. GRP or Group Risk Plan is based on area yields, while GRIP or Group Risk Income Protection, on 'area revenues' (area yield multiplied by price). In 2004, area yield and area revenue policies accounted for 7.4 % of the total insured acreage but less than 3 % of premiums.

In the US, price risk protection is also achieved through the counter-cyclical payments (CCP), established by the 2002 Farm Bill, given when the commodity prices decrease below a target price. The CCP programme becomes effective when the season average marketing price for a commodity is below the national target price for that commodity. There is a maximum payment level per bushel of programme yield, and it is paid on 85% of the programme base acres. Critics of the CCP point out that it addresses price risk only and not production risk, and that it is not based on the crops or acres actually being grown by the producer each year. In order to address both of these problems, the new Food, Conservation, and Energy Act of 2008 launched a new counter-cyclical revenue plan as an alternative

to CCP. The programme is called Average Crop Revenue Election or ACRE for short, and is available to producers of United States Department of Agriculture (USDA) programme crops such as soybeans, wheat, and corn. Although the ACRE programme may resemble crop revenue insurance, there are some important differences. The ACRE guarantees will not fluctuate as much from year to year as crop insurance guarantees. This helps accomplish the fundamental goal of ACRE, which is to stabilise gross revenues over the next four years. On the other hand, the size of the ACRE payment is based on state level yields, not farm yields like most crop insurance policies. ACRE does not protect a farmer who has a poor production year when the state as a whole does not. In addition, ACRE revenue uses the marketing year cash price to calculate actual revenue while crop revenue insurance uses futures prices at harvest time. So, ACRE payments can be a useful risk management tool for sharply falling prices or widespread yield losses (Edwards, 2008).

Insurance in the US is provided by 17 private companies. They work in agreement with the USDA Risk Management Agency (RMA). About 45% of field crops production value are insured (23% in the EU). The average premium rate is close to 9%, much higher than in Europe (4%) mainly because they offer a wider coverage: revenue or yield insurances versus mainly single-peril or combined-risk insurances. The premium subsidies amount to USD 1 900 million (58% of the total premiums). The US government also provides funds for the administrative costs of the insurance companies and provides re-insurance. Thus, the total support provided to insurance would amount to 72% of the total premiums (in the EU, around EUR 500 million = 32% support).

Until 2008, Canada had yield insurance called 'Production Insurance' (PI), and an income programme based on a stabilisation account: CAIS (Canadian Agricultural Income Stabilisation). It started in 2003, and it substituted two former programmes: NISA or Net Income Stabilisation Account and CFIP or Canadian Farm Income Programme. Farmers put an amount of money every year in the individual stabilisation account, which they can withdraw in a year of big losses. CAIS, based on a farm's production margin, was a whole-farm programme available to eligible farmers regardless of the commodities they produced. Government pay a share of funding when producers withdraw funding from their accounts. The programme included coverage (60%) for negative margins.

Since 2008, the New Business Risk Management Suite has replaced CAIS with new programmes (AAFC, 2008). The new suite includes the following.

- **AgriInvest**, a savings account for producers, supported by governments, which provides coverage for small income declines and allows for investments that help mitigate risks or improve market income.
- **AgriStability**, which provides support when a producer experiences larger farm income losses. The programme covers declines of more than 15% in a producer's average income from previous years.
- **AgriRecovery**, a disaster relief framework which provides a coordinated process for federal, provincial and territorial governments to respond rapidly when disasters strike, filling gaps not covered by existing programmes.
- **AgriInsurance**, which replaces the previous yield insurance PI and expands it to include more commodities.

Insurance in Canada is provided by provincial agencies named Crown Corporations, and is partially subsidised by the federal and provincial governments. The subsidies from the federal and the provincial governments total EUR 425.5 million (66% of the premiums).

Index insurance has been experienced for some years in countries such as Brazil, Canada, US or India. Besides area index insurance, India and Canada have developed weather insurance products and Canada also has insurance based on satellite imagery.

### 4.3 Risk management systems in the EU

The main risk management tools in Europe are **Calamities Funds**, **Mutual Funds** and **Insurances**. Aid is often organised in the form of compensation schemes or funds partially financed by the agricultural sector, either on a voluntary or on a compulsory basis (in the form of levies, etc.). **Ad hoc aid** is generally given when no other tools are available. There are often public subsidies for insurance and/or support for re-insurance, either in the direct provision of private insurance or of a public security net (this is the case in Greece and Cyprus).

#### 4.3.1. Funds and ad hoc aids

Public risk management though ad hoc payments or though calamity funds (see Section 4.1) exist in most countries. Ad hoc payments and compensation payments from calamity or catastrophe funds are summarised in Table 1. In some countries, most of the public risk protection concerns animal diseases (this is the case for Ireland, the Netherlands, the UK, etc.) while the crop risk protection is provided privately.

Agricultural insurances are fostered in countries where the law forbids that ad hoc measures or disaster funds compensate for damages that could have been insured. In Greece, Spain, Austria, Portugal and Sweden there are no public fund payments if insurances are available. In France, payments include damages for which there is no insurance at all or for which insurance has not reached yet a significant diffusion level. In Italy, only subsidised risks are excluded from public ad hoc payments after natural disasters. In Romania, public payments are given to farmers if they have insured 'standard risks' like hail. In other countries, it seems that there are no explicit regulations.

We can see very high ad hoc payments in France (2000-05: EUR 1.167 million) and a low level in Spain (2000-05: EUR 22.5 million), but annual subsidies for insurance (Table 2) are higher in Spain (~EUR 230 million/year) than in France (~EUR 5 million). This example shows a different approach for the use of public funds in risk management support. About 50% of the annual ad hoc payments are given for natural disasters like drought, frost, flood and excessive rain, risks which are insurable in countries providing yield insurance.

#### 4.3.2. Insurance

Table 2 shows different types of agricultural insurance systems in Europe, their level of penetration and key figures in each country. Single-risk (mainly hail) insurance is well developed with a long history. It exists in almost all European countries. In general there is a direct relationship between government involvement and insurance development. Usually, private companies insure only hail and fire, and as the government involvement in insurance increases, more comprehensive coverage is provided by the insurance.

Several types of insurance have been classified as 'yield insurance', although some of them are locally called multi-risk insurance. They provide coverage

Table 1. Ad hoc and funds payments in the last years (data from fact sheets)

Country	Years available	Total payment (million EUR)	Average payments/year (million EUR)	Comments
Austria	1995-2004	56	5.6	Frost, drought, flood
Belgium	1985-2002	309	17.2	Livestock dioxin, frost, drought, rain, pests
Bulgaria	2000-04	2	0.4	Insect pest control fund & others
Cyprus	2001-04	29	7.2	-
Czech Rep.	1995-2004	369	36.9	Flood, drought, frost
Denmark	-	-	-	Storm & forest storm damage
Estonia	-	0	0	No payments
Finland	1996-2005	114	11.4	Crop damage compensation scheme
France	1996-2005	1.556 <sup>(1)</sup>	155.6 <sup>(1)</sup>	Drought 67%, frost 19%, rain 13%
Germany	2004-06	337	112.3	Flood 2004 more than EUR 240 million; livestock diseases and preventive measures
Greece	1995-2004	701	70.1	-
Hungary	1999-2002	49	12.2	Frost, drought
Ireland	1999-2004	401 <sup>(1)</sup>	66.8 <sup>(1)</sup>	Livestock disease
Italy	2001-06	680	113.3	Drought and others not covered by insurance
Latvia	2000-05	19	3.2	Frost, drought, rain
Lithuania	2000-05	16	2.6	Frost, drought, rain
Luxembourg	-	-	-	No ad hoc aids for crops. No other data
Netherlands	1998	250	-	Excessive rain; aid not permitted any more
Poland	-	10	10.0	Epidemic diseases
Portugal	last 10 years	30 <sup>(2)</sup>	3.0 <sup>(2)</sup>	-
Romania	last 5 years	57	11.4	Drought, frost, floods
Slovakia	-	-	-	no data
Slovenia	1995-2004	98	9.8	Drought, hail, frost
Spain	2000-05	22	3.7	Frost, drought, rain
Sweden	-	-	-	Infectious diseases
UK	2001-05	1.898	379.5	Livestock disease
<b>TOTAL</b>			<b>919.9</b>	
(Croatia)	1997-2004	-	2.5	EUR 54 million in 2003 for drought
(Turkey) <sup>(3)</sup>	1996-2005	52.67	5.26	Animal disease control aid not included

(1) Of this amount, 50% comes from the sector's private contributions, through taxes on agricultural insurances (France) or from levies on commercialisation of the products (Ireland).

(2) Portuguese farmers also contribute to the calamities fund but the

amount refers to government contributions.

(3) Exchange rate taken into consideration: EUR 1 = TRL 1 674 000 (former Turkish lira, 2005).

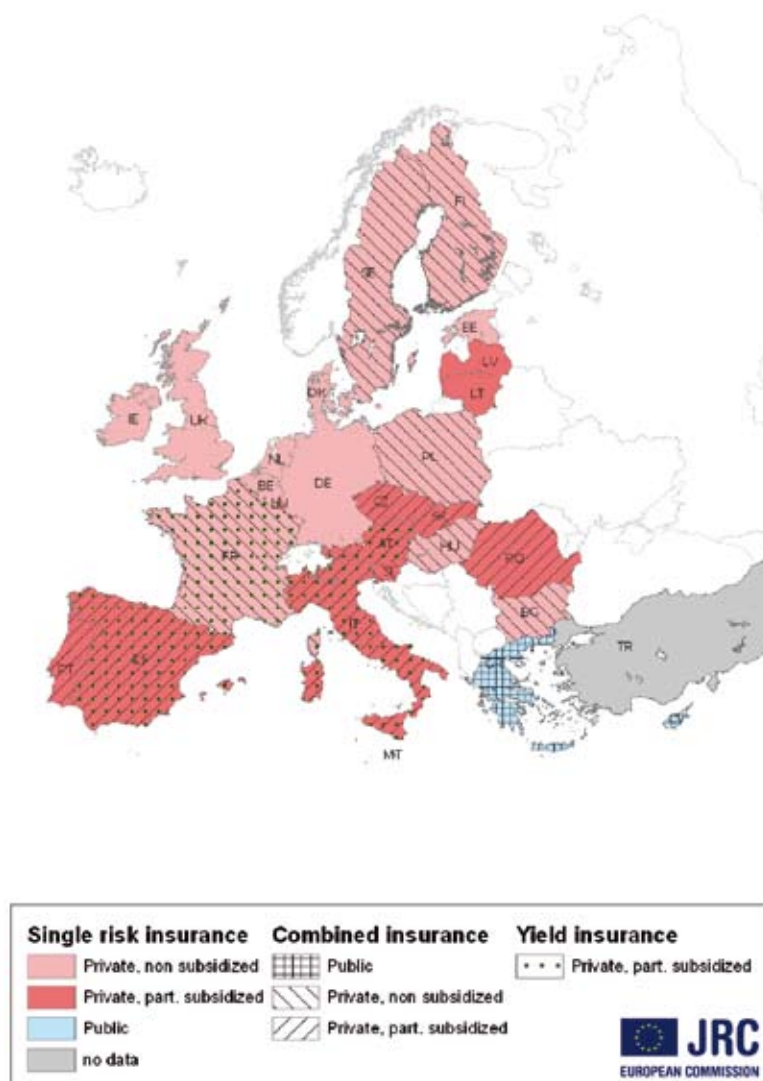
Source: Authors' compilation from fact sheets and own calculations.

against all the main climatic hazards (plant diseases and plagues are usually not covered). In European yield insurances, it is necessary to ascertain which risk caused the loss, while the US ‘Multiple Peril Crop Insurance’ (MPCI) includes yield losses by plagues and diseases, and damages are calculated simply as the difference between guaranteed and actual yield. The European system has higher loss-adjustment costs, but it helps to avoid moral hazard, one of the big problems for the US insurance system.

### Level of development

Figure 1 shows the insurance products available in the different European countries (see also Table 2). In Spain, the government collaborates with farm unions and insurance companies to run the system. All the insurance companies operate in a pool, in a co-insurance regime. Most risks are covered in yield insurance policies. In other countries such as France, Italy, Luxembourg and Austria, the insurance system also is well developed and most risks are covered depending on the contracts. Mostly there is a basic coverage for hail and in addition yield insurance covering the most important risks.

Figure 1. Main agricultural insurance systems in the EU



Source: Authors' elaboration from fact sheet information.

In Bulgaria, the Czech Republic, Hungary, Poland, Portugal, Slovenia, Slovakia and Sweden, single and combined risk insurance is available. Only hail and a few other risks are covered. For Belgium, Germany, the Netherlands and the UK, hail insurance or single-products insurance are the main products available, with negligible demand for other farm insurance products. There is no public support for insurance. In some northern countries, including the Baltic States, there is less demand for crop insurance or they are starting to develop their systems (Latvia and Lithuania). In Finland, private crop insurance is less developed, but there is a public ‘Crop Compensation Scheme’ provided to compensate for yield losses after natural disasters. The schemes in Greece and Cyprus are different: a compulsory insurance system is provided by the public sector.

### The insurance market

The insurance market in the EU-27 is also very different from one country to another. However, apart from some cases of monopoly, we find the common characteristic that in most countries there are few market players, with one or two dominant companies in this very specific sector of agricultural insurance. This suggests that there is a need to promote competitiveness in the sector. This could result in the lower cost of insurance products and could facilitate access for farmers. Also, mutual insurance companies effectively managed by farmers and with a return of the profits to the farmers could be promoted.

Table 2. Agricultural insurance in Europe

Country	Single-risk ins.	Combined insurance	Yield ins.	Market penetration (%)	Insured area (1000 ha)	Premium amount (million EUR)	Premium /insured value (%)	Average indemnities (million EUR)	Insurance subsidies (million EUR / %)
Austria	PS	PS	PS	78	1,054	52,0	2.6%	32,0	24 / 46%
Belgium	P	-	-	n.d.	n.d.	49,0	n.d.	n.d.	0
Bulgaria	P	P	-	52	1,276	6,6	4.8%	4,5	0
Cyprus	GC	GC	-	(100)	112	8,7	7.2%	4,5	4,4 / 50%
Czech Rep.	PS	PS	-	35	1,074	32,0	1.8%	24,0	7 / 30%
Denmark	P	-	-	n.d.	n.d.	n.d.	n.d.	n.d.	0
Estonia	P	-	-	<1	n.d.	0,1	n.d.	n.d.	0
Finland	P	P	-	<1	n.d.	1,8	n.d.	1,1	0
France	P	P	PS	n.d.	3,507	211,0	1.7%	n.d.	5 / 2.4%
Germany	P	-	-	43	7,265	129,2	1.2%	104,5	0
Greece	P	GC+GS+G	-	(100)	n.d.	n.d.	2.5-3%	218,0	n.d.
Hungary	P	P	-	52	n.d.	43,5	n.d.	30,7	0
Ireland	P	-	-	n.d.	n.d.	n.d.	n.d.	n.d.	0
Italy	PS	PS	PS	8	976	271,2	7.4%	166,2	180 / 67%
Latvia	PS	-	-	<1	n.d.	0,1	n.d.	n.d.	0,05 / 50%
Lithuania	PS	-	-	1	9	1,1	4.3%	1.1	0,55 / 50%
Luxembourg	PS	PS	PS	45	26	1,3	2.3%	1.0	0,65 / 50%
Netherlands	P	-	-	n.d.	n.d.	75,0	n.d.	30,7	0
Poland	P(S#)	-	-	7	n.d.	9,9	n.d.	6,3	0
Portugal	PS	PS	-	22	298	46,9	8.4%	30,2	32 / 68%
Romania	PS	PS	-	12	812	14,0	n.d.	4,4	7 / 50%
Slovakia	PS	PS	-	n.d.	n.d.	n.d.	n.d.	n.d.	- / 50%
Slovenia	PS	P	-	17	n.d.	9,5	7.6%	13,8	4,3 / 45%
Spain	PS	PS	PS	26	5,850	564,7	6.3%	388,3	232 / 41%
Sweden	P	P	-	60	1,500	n.d.	n.d.	n.d.	0
UK	P	-	-	7	370	11,1	0.8%	n.d.	0
<b>TOTAL</b>						<b>1,538</b>		<b>1,061</b>	<b>497 / 32%</b>

Source: Prepared from the fact sheets information provided by the experts in each country.

- : Not existing

n.d.: no data

#: Pilot experience

S: Subsidised

P: Private non-subsidised

PS: Private partially subsidised

G: Public non-subsidised

GS: Public partially subsidised

GC: Public compulsory partially subsidised

## Penetration of insurance

In Table 2 we can see that there are high differences in the penetration of insurance. The percentage of insured production value alone is a poor indicator of the development of agricultural insurances. An important indicator is the availability of yield insurance. In some countries (Sweden, Germany), a high level of penetration results mostly from basic coverage in single risk insurance.

## Premium rates

Average premium rates expressed as a percentage of the insured value also have very different levels, from a low level of around 1% in the UK and Germany, and high levels between 6% and 8% in Spain, Italy and Portugal.

Some of the determinants of the level of premium rates in crop insurance are:

- the frequency of risks in time and in area;
- the type of risk (hail, drought) and the number of risks covered;
- the sensitiveness of crops;
- the number of farms insured;
- technicalities like deductibles.

Consequently, comparing average premium rates in a meaningful way is very difficult.

The total premium amount per year in the EU-25 is around EUR 1.539 million (without the public system in Greece), and the average indemnities around EUR 1.061 million.

## Loss ratio

The loss ratio is the proportion between indemnities and premiums paid. For an insurance system to be actuarially sound, the loss ratios should be lower than one (100%) in a quantity enough to pay the administrative and loss adjustment costs. This applies taking into account the entire premiums, including subsidies and all the insurance and re-insurance costs. Average loss ratios have been calculated for the longest period of time available, because they are more representative of the soundness of the insurance systems. However, the available time series of data varied from country to country, so these

ratios are not suitable for comparison. In general, the average loss ratios range between 60% and 75%, with some exceptions. Yearly loss ratios have a strong variation over time due to the high volatility of natural disasters. Re-insurance and public support become essential conditions.

## Level of subsidies

The amount of support provided by EU MS to subsidise insurance premiums varies depending on the country's policy to promote some particular type of coverage, to help some agricultural sub-sector or to facilitate some types of farms. Some countries have integrated it as an essential agricultural policy instrument for the stabilisation of agriculture income.

Table 2 reports subsidies per country, where available. Some additional comments are below.

- **Italy:** around 67% of total premium; 64% for the multi-peril yield-type product.
- **Spain:** around 49% including the regional subsidies.
- **Austria:** around 46% of total premium including regional subsidies; 50% for hail and frost.
- **France:** The 2.5% average of three years is due to a majority of non-subsidised single-risk insurance. Since 2005, new yield products have been launched with subsidies of 35% (40% for young farmers).
- **Portugal:** around 68% of total premium; subsidies vary from 35% to 75%.
- **Czech Republic:** Subsidies from 15% for live-stock to 30% for crop insurance.
- **Slovenia:** Subsidies for crop insurance given the first time in 2006. For basic risk coverage (hail, fire and thunderstorm), 30% to 50%.
- **Latvia and Lithuania:** 50% subsidy, but still very low penetration of insurance.
- **Cyprus:** 50% for all insurable risks in the compulsory scheme.
- **Luxembourg:** 50% for all insurable risks.

The annual subsidies of agricultural insurance in the EU-25 are around EUR 497 million (32% of premiums). The average amount of ad hoc aid in the EU-25 is EUR 904 million (it does not include all aid given for livestock).

- **Croatia:** A maximum of 75% including state (25%), county and municipality subsidies (since 2003).
- **Turkey:** 50% since 2006.

### Some other technicalities

#### Re-insurance

In most countries, re-insurance is undertaken by private companies in the international market. However, there are some exceptions in which insurance is totally or partially managed by the government or public companies. This is the case for Portugal and to a lesser extent for Spain and Italy.

There are two main types of re-insurance systems used in agriculture: non-proportional re-insurance such as stop loss re-insurance, and proportional re-insurance such as quota-share re-insurance.

#### Triggers and deductibles

There is a variety of different deductibles with a range from 0% to 40% and more. Some generalities are noted below.

- The higher the risk, the higher the deductibles. This can mean that the risk is high (high frequency in time or affecting a large area) or that the crops covered are very sensitive (e.g. fruits, vegetables).
- Flexible deductibles are often used to provide individual insurances tailored to the demands of customers: for a higher deductible, they pay a lower premium.
- In general, new insurance products (less experienced) have higher deductibles.

The losses can be evaluated per field, per crop (all fields with the same crop in the farm), or even per farm in whole-farm insurance products. In single-risk insurance products, such as hail insurance, losses and deductibles mostly are calculated per field.

#### Bonus-malus system

The bonus-malus system or system of deductions and penalties on the premiums due to former results is used to avoid moral hazard and adverse selection problems. It is applied in Bulgaria, Germany, Estonia, Spain, Lithuania, Luxembourg, Hungary, the Netherlands, Austria, Romania and Finland. In Greece, this does not exist for compulsory public insurance, but it does for private insurance. In Denmark, Ireland, Portugal, and the UK, there is no bonus-malus system. In Belgium, there is no bonus-malus system applied by the Belgian companies, but it is applied by the Dutch Hail insurance Company (OFH), which is the main insurer for apples and pears. In France and Italy, no information was provided, and in Poland, Slovenia and Sweden, it seems not to be applied in crop insurance, but it is applied in livestock insurance.

#### Compulsory insurance on crop level

In most countries and for most insurance products, it is compulsory to insure all fields with the same crop, to avoid only fields with higher risks being insured (another type of adverse selection). Sometimes the insurer excludes specific areas from the coverage.

#### Loss assessment

Normally the loss assessment is performed by loss adjusters in the field. To estimate the loss, they use field work protocols developed for different crops. There are international expert meetings every year organised by the International Association of Hail Insurers (AIAG) to exchange experiences. The loss assessment for single risk (hail) insurance in the countries is very similar.

For indirect-index insurance, the loss assessment is based on indices (meteorological data) or on area yield in area-based-index insurance, but these new insurance products in Europe are based mostly on project or pilot studies.

#### 4.3.3. Risk management for livestock

The main type of risk in the livestock sector is the sanitary risk, but catastrophic climatic events can also have a direct impact on the animals (floods, etc.) and other weather events can affect pasture and forage availability and therefore the economic sustainability of the farm. To a minor extent, the Directorate-General for Health and Consumers (DG SANCO) has undertaken an in-depth study on the

risk management tools for livestock sanitary crisis. In the main report of this study, we give a summary of the conclusions reached and explore insurance on risk indices of pasture and fodder production.

Livestock epidemics can result in substantial losses for governments, farmers and all the other participants in the livestock production chain involved. MS are obliged to apply the control measures established in EU directives if an outbreak of 'List diseases' arises (Office International des Epizooties <sup>2</sup>, 1998). In 2006, the European Commission (EC, 2006c) approved a financial package of EUR 193 million to support programmes to eradicate, control and monitor animal diseases during the year 2007. The 155 programmes which were selected for EU funding will deal with animal diseases that impact both human and animal health. The large EU contribution towards these programmes reflects the high level of importance attached to disease eradication measures, for the protection of both animal and public health.

In the livestock sector, there is a different treatment for direct losses and for consequential losses. MS governments and European institutions generally support the largest part of the direct losses due to mortality or morbidity, such as the value of destroyed animals. Some MS finance the non-EU compensated *direct losses* from the national budget (Denmark, Ireland, Spain, France, Italy, Luxembourg, Portugal, Finland, Sweden and the UK). Other MS have set up some form of statutory system to co-finance the direct losses. These public-private financing schemes have a compulsory fund structure in which all farmers pay a tax (Belgium, Germany, Greece, the Netherlands and Austria) (Koontz et al. 2006).

Consequential losses, such as losses resulting from empty buildings and movement standstills, are most often completely borne by the farmers themselves. Some EU MS partly compensate for consequential losses in a form of ad hoc relief programmes (Belgium, Ireland, Austria, etc.) or by compensating above the value of the animals that are forcibly slaughtered to cover part of the consequential losses (Asseldonk et al. 2006). In some other EU MS, the absence of public assistance has led to the creation of private insurance schemes for some types of livestock production (Germany, Spain, Italy, Netherlands, Sweden and the UK). There are

also some forms of public-private partnership in which the government acts either as an insurer or a re-insurer of a subsidised consequential loss insurance policy (Greece, Spain) (Meuwissen et al., 2003). Producers do not commonly take up private policies that are specifically designed to cover sequential losses.

#### 4.4 Discussion on the possible implementation of European risk management products

The analysis of the current risk management tools shows that there is still need for high public intervention in the form of *ex post* aid. The existing insurance level is generally insufficient to smooth out significant income reduction in bad years. The risk management tools available in the MS could be further developed. However, given the heterogeneous situation in the MS, the interest in a harmonised EU-wide agricultural risk management scheme is debatable.

Conditions for a feasible EU-wide insurance scheme have been analysed (see Bielza et al. 2008a) according to the following: (a) political criteria; (b) socioeconomic criteria; and (c) technical criteria. The possible amount of costs of a hypothetical EU-supported insurance system has been roughly quantified for a few hypothetical scenarios, under given assumptions. A 50% subsidy of the national premiums of all the countries, assuming an insurance demand of 40%, would be approximately of the order of magnitude of EUR 1 billion for income insurance, EUR 0.55 billion for yield insurance on arable crops, EUR 0.3 billion for area index insurance for cereals and EUR 0.3 billion for fruits. However, these estimations rely on strong hypothesis. Among the different types of insurance analysed, revenue insurance would be more expensive but more efficient as an income stabiliser, while indirect index insurance would be cheaper and easier to manage but usually less correlated with farmers' income.

Altogether, given the high diversity of risks and of socioeconomic backgrounds in the EU-27 MS, it does not seem advisable to settle on a homogeneous common insurance system. Some alternatives can be a set of actions to encourage national systems:

- facilitating/subsidising the composition of databases, preferably at farm level;
- providing public re-insurance;

<sup>2</sup> The Office International des Epizooties (OIE, French for 'International Epizootic Office'), is now known as the World Organisation for Animal Health.

- partially subsidising national systems;
- establishing a common regulatory framework for these actions and adequate control tools. This common framework should always set the level of public support within the limits established by the WTO agreements and take into account current EU legislation.

The simulated insurance scenarios presented in the report (Bielza et al. 2008a) are only a first step

towards assessing the potential of the different insurance products. Considering the advantages of index insurance products over other types of schemes, it seems worthy to undertake the feasibility analysis of different possible index insurance schemes based on meteorological, agrometeorological and satellite imagery parameters. Moreover, those indices could also function as control tools for estimating the potential public compensation for catastrophic losses.

## 5. Technical feasibility of a European index for risk management

### 5.1 Introduction

The current section focuses on the assessment of index tools for agricultural insurances. A comprehensive literature review of index insurances available in the world can be found in the scientific and technical report *Agricultural Insurances Schemes II* (Bielza et al. 2008b). Index insurances basically differ from traditional agricultural insurances in that they do not refer to the actual farm losses, but to the losses evaluated from an index. This index can be, for example, some area yield or revenue, some meteorological or agrometeorological parameter or a satellite imagery parameter. The analysis considers the effectiveness to deal with the risk of substantial income reduction of farmers. The study evaluates index insurances in EU-27, and makes a cross-validation of index insurances based on the loss risk calculated from farm data (FADN). However, most aspects of the study are restricted to the EU-15 because of data availability, in particular for the FADN loss risk assessment, for which long time series are not available for the new MS. Income indicators based on FADN data have been taken into account since 1994, yield indicators from Eurostat data since 1975, meteorological and agrometeorological indicators since 1975 and indicators based on coarse resolution satellite images since 1998.

### 5.2 Discussion on feasibility of index insurance in the EU

Some characteristics of index products have to be taken into account in the analysis of feasibility.

- Index products are useful for systemic risk, at the aggregate level, so they are more adapted to re-insurance and catastrophic risks.
- Index-based products are best suited for homogeneous areas, where all farms have correlated yields. Given the heterogeneity of climates and geography in many European countries, the efficiency of index products will be probably lower than in the large homogeneous areas of the US (for example, the corn belt).
- Insurance can be properly designed when there are yield time series available (or losses time series). In Europe, time series are only available for relatively large regions. Some of these regions are quite heterogeneous in terms of cropping conditions, climate, topography and soils. This creates difficulties for the efficiency of index insurance for all farmers in the region.

Besides, insurances have to comply with European and international regulations. If insurance is to be considered within the CAP framework, the subsidies should comply with WTO Green Box criteria. Subsidies of index insurance could be considered as payments (made either directly or by way of government financial participation in crop insurance schemes) for relief from natural disasters (Paragraph 8 of An-

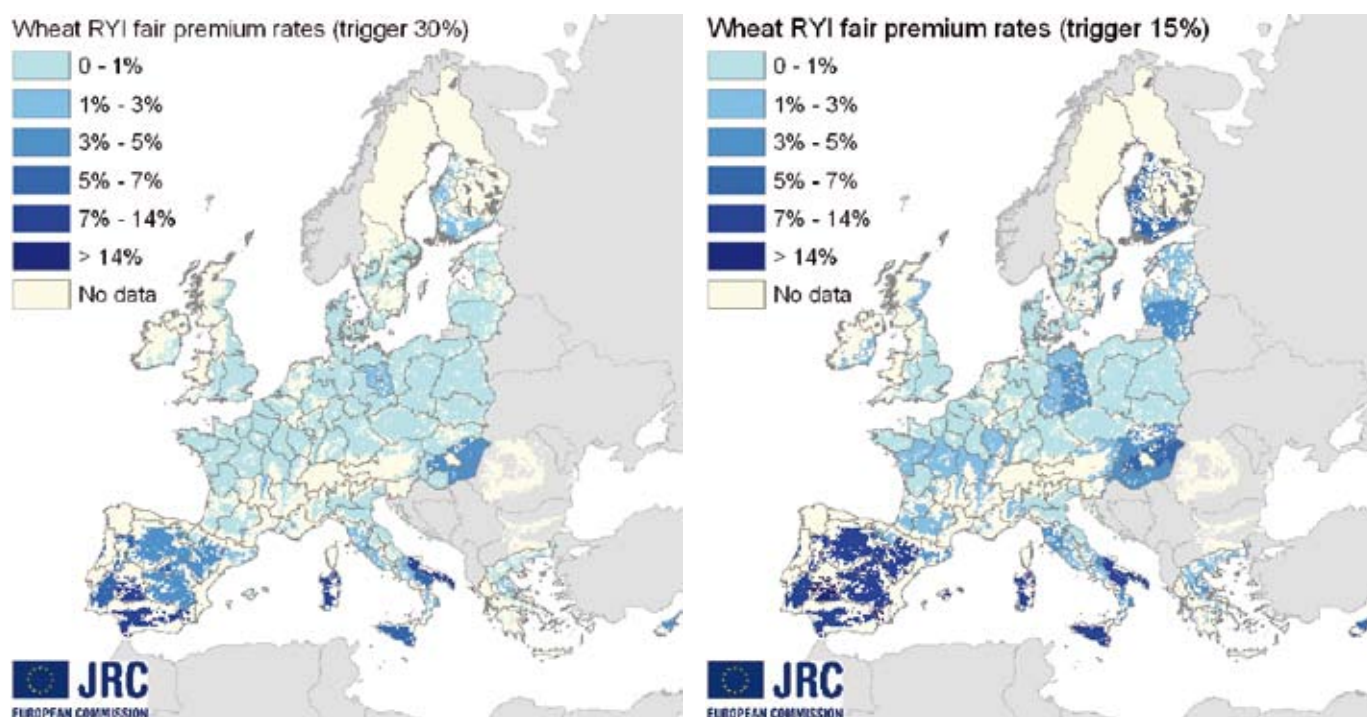
nex 2 of WTO Agreement on Agriculture), because indices are intended to reproduce yield or production risks. However, it is not clear whether index insurance by its nature can be considered under the Green Box, given that its nature is not to compensate for the actual loss of an individual, but the loss indicated by a parameter (a farmer that did not suffer from a loss could potentially benefit from compensations). Practical difficulties would also arise from the requirement of a formal recognition by the governmental authorities of natural disaster, as it would have to be linked to a certain threshold for the indices used. Other technical characteristics of the insurance and its compliance with the Green Box criteria are also analysed.

### 5.3 Regional (FADN region) yield index

Given that in the US, area yield index insurance has been successful, we have designed a hypothetical RYI similar to the US GRP. However, it is non-proportional insurance in the sense that the deductibles due do not decrease as the loss increases. This represents the first attempt to design an area index insurance scheme at European level. It was designed from Eurostat-REGIO data and applied at the level of FADN region.

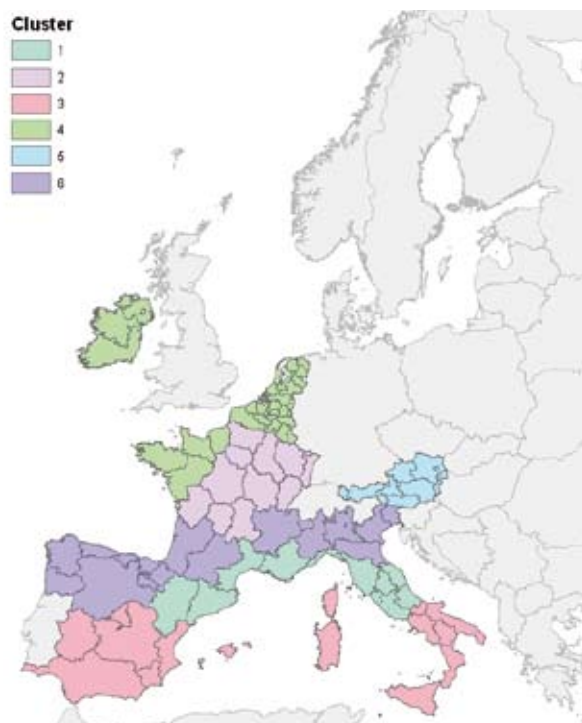
We have estimated the premiums rates and the maximum total premium amounts. The calculation of the risk that is covered by the insurance company results in a risk rate known in technical terms as 'actuarially fair premium' rate (also risk premium or fair premium). We have expressed it as a percentage of the total insured amount. From this fair premium, the commercial premium is then estimated by adding the management and administrative costs and the profit of the insurance company, re-insurance, etc. The fair premium rates for wheat with a trigger of 30% and no deductible ranges from 0% to 14%, with average of 1.1%. The average seems quite affordable, but the maximums are very high. This highlights the large variation of yield risks between different regions. The premium with a 30% deductible was also calculated. In this case, the maximum would reach 6.48% and the average 0.25%. We should underline here that the risk of falling by 30% of a regional average is much lower than the risk of falling by 30% for an individual farm. This explains why the average fair premium of 0.25% is low. With a 15% trigger, wheat premium reaches 15.7% in Spain. On the whole, these results show that premium rates are very sensitive to the deductibles and trigger levels. The total premium amount can be multiplied by 2 or even up to 6 when reducing the trigger from 30% to 15%.

Figure 2. Premium rates for RYI for wheat (trigger 30% and 15%)



Source: Elaborated by authors from Eurostat data.

**Figure 3. Some clusters of NUTS-2 regions to estimate the explanatory power of agrometeorological indices on the yield of main crops**



Source: drawn up from Eurostat data.

The commercial premiums of RYI with a 30% trigger and a 50% market penetration (and assuming there is no adverse selection) and assuming a load on the fair premium of 42%, could be around EUR 77.6 million for potato, EUR 79.5 million for barley and EUR 69.8 million for wheat, of which EUR 54.67 million, EUR 56 million and EUR 49.1 million respectively are the pure premiums. The country average fair premiums per hectare oscillate between EUR 4.17 and EUR 9.17 for most arable crops, but reach EUR 30.70/ha for potato.

#### 5.4 Meteorological parameters or weather indices

In this section, we analyse the possibilities of a number of indices. Panel models have been adjusted to Eurostat time series of yield at NUTS-2 level. Tests have been concentrated on wheat, in order to identify a suitable approach to apply to a wider range of crops. Regions with roughly similar climatic conditions have been grouped in clusters. Figure 3 shows the geographic layout of the clusters of regions. Please note that this map and the related models refer only to countries for which data are available at NUTS-2 level. In particular, this

excludes countries like Germany, where data are available at NUTS-1 level, and other countries for which some elaboration is still necessary to adapt the existing data.

The indicators analysed are as follows: Emberger-continentality; rainfall seasonality; dry soil days; moisture; GDD yearly; desertification; accumulated frost yearly and dryness (3). Results showed that these combinations of indicators do not explain yields optimally, as the Multiple R-Square is only 30%. Perhaps other indicators should be explored. Besides, it is also possible that there is too much heterogeneity within each NUTS-2 region and a meteorological yield-tailored index could only have a good explanation capacity at a more disaggregated level. The meteorological indices analysis is useful to underline that the index risk can differ very much from one European region to another.

#### 5.5 Parameters computed from an agrometeorological model

Agrometeorological parameters are built by modelling the crop growth, based on the Crop Yield Forecasting System (4) (CYFS-MARS). Three parameters were selected to study their potential to explain yield variability: Relative Soil Moisture (RSM), Total Water Consumption (TWC) and the Water Limited Storage Organ Weight (WLSOW).

Assuming that the Eurostat-REGIO yield is a good indicator of the yields to be insured (or re-insured since we are working at regional level), we have calculated the correlations of these yields with the three parameters mentioned above. Only in some cases, correlations are very high. Some examples regard the RSM, which reaches in Baden-Württemberg (Germany) a 0.96 correlation on 10 years, or TWC, which reaches 0.74 on 29 years in Bretagne (France), both for grain maize.

The analysis of the agrometeorological indices is made on a large scale (EU-27); this factor certainly limits the quality of the results, because of the climatic differences within Europe. For example, certain areas suffer from a lack of water, while others

3 References for these indicators can be found in Chapter 4 of the *Agricultural Insurance Schemes II* report (Bielza et al. 2008b).

4 See <http://mars.jrc.ec.europa.eu/mars/Projects/Methodology-of-the-MARS-Crop-Yield-Forecasting-Systems-METAMP> online.

face problems due to excessive rain; this means that it is sometimes problematic to analyse the same index on areas with different meteorological characteristics. At present, the results raise major doubts on the application of index insurances based on agrometeorological indicators in the EU. The study suggests several directions that could be taken to comprehend how far an index can be useful to assess losses due to climatic events or to prevent income losses through an insurance scheme based on agrometeorological indices.

### 5.6 Parameters from satellite images

Analyses for the Normalised Difference Vegetation Index (NDVI) computed on SPOT4-VEGETATION images show that the maximum NDVI (max. NDVI or maximum value of the Maximum-Value-Composite-NDVI of the year) appears as a poor indicator of crop yield risk in the European conditions. While a good *spatial* correlation can be observed between max. NDVI and yield, the *time* correlations in each FADN region are low. A factor negatively influencing these correlations is the shortness of the time series (only seven years). However, correlation results improved when taking into account only those max. NDVI which fall in the period when the crop is more sensitive to nutrients and water stresses. This means that the capacity of NDVI for explaining

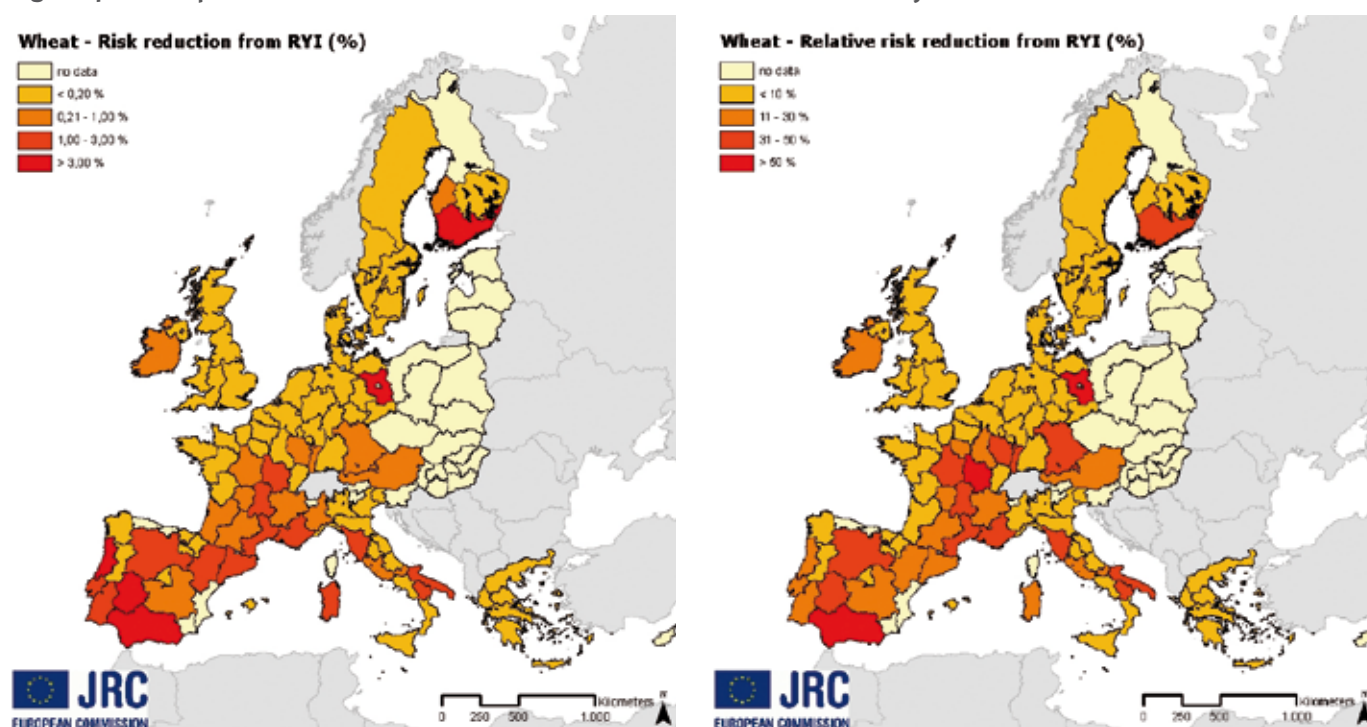
yields could be improved by exploring other NDVI-based indicators, such as the max. NDVI of this sensitivity period.

Moreover, ongoing activities within the MARS Unit of the JRC have proved that the correlation between the indicators derived from NDVI and yield is dependent on the regions. A study in Spain showed that the max. NDVI but also cumulated NDVI values for different periods of the growing season are significant. Further analysis could include indicators such as the start NDVI or the end NDVI of the growing season, the cumulated NDVI during the length of growing season, and cumulated NDVI between start and max. NDVI or between max. NDVI and end NDVI of the season.

### 5.7 Cross-validation of indirect index insurance with FADN data

The objective of this section is to validate the index insurance with individual farm data from the FADN, the best available source of data at single farm level, and they allow for setting up the link between the index-based triggers and the risk of yield or income losses at farm level. With this objective, individual farm yield and income risk were analysed at FADN region level. In a second step, farm risk is again calculated, this time assuming that all farms buy an in-

Figure 4. Wheat production risk reduction and relative risk reduction from area yield insurance



Source: Elaborated by authors from FADN and Eurostat data.

dex insurance. The decrease of the farm risk gives an indication of the efficiency of the index insurance.

The methodology used to calculate the risk from FADN data was developed by the research project team (JRC-IPSC) and it is explained in detail in the main report (Bielza et al. 2008b). It mainly consists of the '2-year constant sample' method, and a 'moving-average' method that tries to reproduce the WTO criteria for agricultural risks compensations.

In order to see the effects of the area yield insurance (RYI) on the farm economic results, we will not take into account the whole farm income, given that previous analyses have shown that farm income risk is not very much related to farm production risk, because of the effect of other income components which often are not intrinsic to the farming activity. So, we will look directly at the effect of area insurance (RYI) on the farm crop revenue.

We have made a cross-validation of the RYI (FADN region and yields from Eurostat-REGIO data) with the farm revenue from the crop. The test for risk reduction capacity of the other indices could be performed. However, it would be expected to be lower than the one from yield area index, given that theoretically regional yield area should describe the behaviour of farm yield better than other indices at a regional scale.

## 6. Conclusions

The level of risk is very heterogeneous in the EU, from country to country, from one farm type to another and from small to large farms. The development of agricultural insurances in each country is linked to the risk level, but the MS policy to support the system is also a decisive factor. The regulation of public aids to agriculture differed between MS until 2006, although most MS followed the Commission Guidelines. Since December 2006, when a regulation (EC, 2006a) on the application of Articles 87 and 88 of the Treaty was adopted together with new Commission guidelines (EC, 2006b), MS have had a common legal framework for bestowing disaster assistance. This framework allows them to keep their own policy that suits their risk exposure and their agricultural systems best.

Although data from some countries are still missing or incomplete, this study represents a

As mentioned above, the risk was calculated both for the original sample with no insurance and for the new sample with insurance. In order to calculate the risk 'with insurance' we have proceeded in the following way. We have applied to each FADN farm revenue (assuming a unitary price) the indemnities and the premiums from the RYI. By thus simulating the effects of RYI on the farms, we have obtained new values for the farm revenues with insurance. The comparison of both results allows us to quantify the potential effects of the insurance on the average risk of the farms.

The maps in Figure 4 show the risk reduction results for wheat and the risk reduction expressed as a percentage of the original risk. The observed risk reduction capacity of RYI is in general not very high for the example analysed. This is not surprising given that area yield indices are more adequate for homogeneous regions. We can expect that the results do not depend on the crop type, but on the scale of the analysis. Besides, we have to take into account that it was underestimated due to the data constraints. However, there are some regions where the risk can be reduced up to 68%. These results have to be considered cautiously, given that the quality of the data is not optimal. The correlations between Eurostat yields and FADN yield averages are often weak.

unique collection of information of the agricultural insurances systems in the EU-27. The analysis of the information provided by the experts throughout the EU shows that for non-systemic risks (hail), the private sector offers suitable insurances, but for insurance products offering a wide coverage, there is a direct relationship between development and public support. The development of insurances in the livestock sector is generally lower than in the crop sector. Livestock risk management relies on sanitary assistance programmes; major crises (diseases with high externalities) are covered by public aid. The total amount of premiums in the EU agricultural insurances is around EUR 1.5 billion with a public subsidy of approximately EUR 500 million. The average amount of compensations for losses by farmers is close to EUR 1.1 billion. The total amount of ad hoc aids for which we could collect data is slightly above EUR 900 million, but

many countries did not provide data on ad hoc aid for livestock. Therefore, this figure is probably strongly underestimated.

In the last years, many MS policies have searched to further develop insurance, by increasing the risks covered and by covering new crops and livestock. This fact, together with the high amount of ad hoc aids that are still bestowed by governments, shows that the current insurance level is generally insufficient to smooth major income reduction in bad years. This implies that the risk management tools available in the MS could be further developed.

Some suggestions to encourage national systems are:

- facilitating or subsidising the composition of databases, preferably at farm level;
- providing public re-insurance;
- partially subsidising national systems.

Should these options be promoted at EU level, a common regulatory framework and adequate control tools would be needed.

The analysis and comparison of the different insurance schemes at European level have shown the relative advantages of index products potential over other type of schemes for risk management at EU level. Therefore, it seemed worth undertaking the feasibility analysis of different possible index insurance schemes based on meteorological, agrometeorological and satellite imagery parameters. Moreover, those indices could also function as control tools for estimating the potential public compensation for catastrophic losses.

Due to their nature, index-based products are best suited for homogeneous areas, where all farms have correlated yields. Given the heterogeneity of climates and geography in many European countries, and that analysis had to be performed at NUTS-2 or FADN region level, which is at large scale, index products efficiency results to be relatively low. It could be expected to be more useful for re-insurance, at the aggregate level, than at the farm level.

Premiums have been evaluated for a RYI for FADN regions and a number of arable crops. Results show that fair premium rates are very sensitive to the deductibles and trigger levels. Some meteorological

indicators were also analysed. The combinations of those indicators do not explain yields optimally. Perhaps other indicators could be explored, but there seems to be too much heterogeneity within each NUTS-2 region and a meteorological index could only have a good explanation capacity at a more disaggregate level. Similar conclusions were derived from the agrometeorological indicators tests. The meteorological and agrometeorological indices analysis is useful to underline that the index risk can differ very much from one European region to another. Analyses for NDVI show that the maximum NDVI appears as a poor indicator of crop yield risk. However, the capacity of NDVI for explaining yields could be improved by using the cumulated NDVI between the more sensitive crop development stages.

The cross-validation of area yield insurance with FADN data shows, as could be expected, that the risk reduction capacity of yield area index is not very high for the case analysed, even though there are some regions where the risk can be reduced up to 68%. The test for risk reduction capacity of other indices would be expected to be lower than the one from area yield index, given that theoretically regional yield should describe the behaviour of farm yield better than other indices at regional scale.

This study provides a complete picture of the existing risk management tools available within the European MS. It also provides a rough estimation of the potential cost of index insurance, identifying in which cases a specific type of insurance is more suitable for buffering a specific vulnerability, taking into account the risk and environmental diversity of Europe.

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## 8. Glossary

**Adverse selection:** A situation in which the insured has more information about his or her risk of loss than does the insurance provider and is better able to determine the soundness of premium rates. As a consequence, the level of risk in the insured population is higher than in the total population (Harwood et al. 1999).

**Asymmetric information:** relates to the problem that the buyer of insurance and the insurance company may not have the same information as regards the probability of losses occurring. Asymmetric information can result in one or both of these problems: adverse selection and moral hazard.

**Deductible or excess (French: *Franchise*):** The portion of an insured loss to be borne by the insured before he is entitled to recovery from the insurer. It may be in the form of an amount of euro, a percent of the value of the insured property (**straight deductible**) or a percent of the loss (**relative deductible**). The trigger is the percentage of the insured value the losses must exceed in order to trigger the payment.

**Moral hazard:** In the case of insurance, moral hazard refers to an individual's change in behaviour after having taken out an insurance policy. The change in behaviour results in an increase in the potential magnitude and/or probability of a loss.

**Non-proportional re-insurance:** The coverage of the re-insurer is based on the loss. The re-insurer takes charge of the loss above a certain threshold of the loss. It is similar to insuring with a straight deductible.

**Stop-loss re-insurance:** The re-insurer takes charge of the losses above a fixed threshold of the annual balance (annual loss or loss ratio) of the insurance company.

**Proportional re-insurance:** The coverage of the re-insurer is based on the sum insured. It is more similar to insuring with a relative deductible.

**Quota-share re-insurance:** The re-insurer assumes a set percentage of risk (covered sum insured); in this quota the re-insurer takes charge of the loss of the company and the same share on the profit.

**Systemic risk:** As opposed to risks like fire and burglary, systemic risks affect a big population at the same time. Systemic risks result in many people making a claim at the same time with the effect that the premiums paid into a pool are not sufficient to cover the loss incurred, which may threaten the solvency of the insurance pool. An example for systemic risks is price risk. All producers suffer from price downturns at the same time.

## 9. Acronyms

ACRE	Average Crop Revenue Election	IP	Income Protection
AGR	Adjusted Gross Revenue	ISPC	Institute for the Protection and Security of the Citizen
AIAG	International Association of Hail Insurers	JRC	Joint Research Centre
AWU	Annual Working Unit	LGM	Livestock Gross Margin
CAIS	Canadian Agricultural Income Stabilisation	LRP	Livestock Risk Protection
CAP	Common Agricultural Policy	MARS	Monitoring Agricultural ResourceS
CAT	Catastrophic Insurance	MPCI	Multi-Peril Crop Insurance
CCP	Counter Cyclical Payments	MS	Member State
CEA	European Committee of Insurers	NDVI	Normalised Difference Vegetation Index
CFIP	Canadian Farm Income Programme	NISA	Net Income Stabilisation Account
CRC	Crop Revenue Coverage	OFH	Dutch Hail Insurance Company
DG AGRI	Directorate-General for Agriculture and Rural Development	OIE	Office International des Épizooties
DG SANCO	Directorate-General for Health and Consumers	PI	Protection Insurance
EC	European Commission	RA	Revenue Assurance
ECHO	European Commission Humanitarian Aid Department	RMA	Risk management agency
EM-DAT	The Emergency Events Database	RYI	Regional Yield Insurance
EU	European Union	SAPS	Single Area Payment Scheme
EUR	Euro	UN/ISDR	United Nations International Strategy for Disaster Reduction
FADN	Farm Accountancy Data Network	US	United States of America
FP6	Sixth Framework Programme	USDA	United States Department of Agriculture
GRIP	Group Risk Income Protection	WTO	World Trade Organization
GRP	Group Risk Plan		

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**Abstract**

This report summarizes the results of two studies requested by the European Parliament through DG Agriculture. The current tools of EU Member States for agricultural risk management are presented, highlighting the main types of approaches. The financial volumes of insurances and ad-hoc state aids are compared. For meteorological events that are typically local, such as hail, the available insurance products are generally sufficient, but coverage of systemic events, such as drought, needs to be boosted in most countries. The level of some major risks is quantified and mapped with the help of the meteorological database of MARS unit of JRC. The suitability of index insurances is analysed; the principle is that compensation to farmers is triggered by yield statistics, agro-meteorological indexes or satellite images; the results suggest that such insurances are appropriate only when individual damage assessment is too difficult to carry out.

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