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Risk Analysis in the Agricultural Industry at European Union Level

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Abstract

Specialized literature includes a lot of approaches related to the classification of risks that differ both according to their classification characteristics and the purpose and objectives of the research. Considering the impact of climate risk in global or national economies, the objective of this paper is to analyze the risks faced by the European economy in the agricultural industry. Following the analysis, it was observed how important the agricultural industry is in the European economy, being cultivated approximately 40% of the surface of Europe. It can be noted that, together with Poland, Germany and France, Romania is one of the largest producers of cereals in the European Union, 40% of agricultural production being represented by cereals. It is also very important to note that the agricultural sector is the only sector for which support was achieved at the level of the European Union through the common agricultural policies program (CAP).

Keywords: Agriculture Risk, Climate Change, Crop Yield, Cap, Market Price

Introduction

Specialized literature includes a lot of approaches related to the classification of risks that differ both according to their classification characteristics and the purpose and objectives of the research. Agriculture is an inherently risky activity. Crop yield and animal husbandry depend on weather, which in many regions of the world is highly variable. Drought, excessive moisture, plant pests and diseases can significantly affect crop yields and pasture quality. This in turn affects animal feed and feed, which affects meat and dairy production and can also cause livestock loss. In addition, as related to production uncertainty, most agricultural producers must make decisions about planting crops and replacing herds without knowing what the price of their product will be when plants harvested or animals slaughtered. As a

result, farm incomes are usually significantly variable, and farms are exposed to potentially large losses as well as unexpected profits in certain years.

The agricultural sector in the European Union operates within the framework of the Common Agricultural Policy (CAP). Just as agriculture must keep pace with scientific and technological progress, so the common agricultural policy must respond to emerging challenges.
The risks analyzed in the agricultural industry at the European level are divided in different categories:

- Agricultural markets (price level and volatility);
- Agricultural production;
- Climate-related risks and the impact of climate change on agricultural production;
- The financial, institutional, legal and political context.

Literature Review

Over time, risk has been defined in many ways, these definitions are not entirely true or false, but they are useful tools for creating important commonalities (Rosa, 1998 and Habegger, 2008). The dictionary defines risk as the chance of harm, damage or loss (Webster, 1983 and Habegger, 2008). In addition, a distinction can be made between the meaning of the concept of risk, from a technical and non-technical point of view. From a technical point of view, the notion of risk can have different meanings, depending on the discipline in which it is used, starting from the cause, or the probability of the occurrence of an undesirable event that may or may not occur and arriving at the decisions made under conditions of probabilities known. Risk is a multifaceted phenomenon with various characteristics. It is often defined as the potential for resource loss or insufficient income compared to the possibility of optimal resource utilization. Another definition describes risk as the conscious acknowledgment of the potential for unexpected losses in anticipated property profits or money, due to accidental changes in economic conditions or unfavorable circumstances (Libanova, Gorbulin, 2015). The complexity and diversity of risk necessitate multiple definitions depending on the research objectives. However, all risks share common traits: they involve the danger of loss and manifest as natural phenomena or societal events. This allows for a general definition: risks are phenomena or events with probable or foreseeable occurrences that may lead to negative consequences. This broad definition aligns with the principles of risk management, aiding in effective risk management practices. Among the various categories of risks, social risks are the most prevalent, impacting the population's standard and quality of life.

Research Methodology

The study employs a qualitative research approach to investigate different risks that affect the agricultural industry in the EU. The identified information will help for a better understanding of all factors that have to be taken into account in order to have successful agricultural business.

The methodology involves analyzing and discussing the factors and risks within each category of risks, drawing on existing literature and research in the field of agriculture. The paper provides explanations and insights into the impact of climate change, market dynamics, policy reforms, and other factors on agricultural production and income.

However, through this paper we want to present information and analysis based on available data and knowledge in the field of agriculture, which is a common approach in qualitative research.

Below you the approach from the three points:

- Literature Review: The paper analyzes the existing literature and research in the field of agriculture to provide insights and information about the various risks and factors affecting agricultural production. This involves reviewing and analyzing academic papers, reports, and other relevant sources to gather information and understand the current state of knowledge in the field.
- Data Analysis: The paper includes the analysis of data, such as historical price trends, production figures, and climate data, to support the discussion and provide evidence for the claims made
- Qualitative Analysis: The paper provides qualitative analysis by discussing and interpreting the findings from the literature review and data analysis. It offers explanations, insights, and observations about the risks and factors affecting agricultural production, such as the impact of climate change, market dynamics, and policy reforms

Overall, the methodology used in the paper combines the review of existing literature, analysis of relevant data, and qualitative analysis to provide a comprehensive and informed discussion of the risks and factors affecting agricultural production. This approach allows for a deeper understanding of the topic and provides insights that can inform decision-making and policy development in the agricultural sector.

Risks in Agriculture at European Level

As mentioned risks analyzed in this paper are divided into; Agricultural markets (price level and volatility); Agricultural production (including risks related to animal and plant health and events determined by climate and environmental changes); Climate-related risks and the impact of climate change on agricultural production; The financial, institutional, legal and political context.

Agricultural Markets (Price Level and Volatility)

It is known that in the last two decades, in several agricultural markets, price volatility has increased significantly. When analyzing long-term price volatility trends, it is evident that phases of high and volatile prices are frequently succeeded by extended periods of relatively low and stable prices.

In order to analyze the evolution of price volatility it is important to take into account the following aspects (European Commission, 2017):

- Agricultural yield varies from period to period due to environmental changes, weather and pests. Agricultural production is biological in nature and the growing process often requires a long period of time. This has two implications: on the one hand, supply cannot respond much to short-term price changes, however, it can do so to a greater extent when the production cycle is completed; On the other hand, due to the lag between production decisions and actual production (planting to harvesting), farmers must rely on market

expectations regarding future prices at the time they plan to sell their products. As a result, the elasticity of supply is low, at least in the short term. Similarly, the demand for agricultural products is generally unresponsive to price changes. Therefore, significant price adjustments may be necessary to rebalance supply and demand after a supply imbalance, especially when inventories are low and the market's buffering capacity is limited. Additionally, the delayed response of supply to price fluctuations can cause cyclical adjustments, introducing further variability to the affected markets.

- The production cycle can create seasonal patterns, resulting in predictable monthly price fluctuations throughout the year. This predictability allows farmers to anticipate and adjust their behavior accordingly.
- Fluctuations in demand for non-food agricultural products due to business cycles can also lead to increased price volatility.
- There is generally a difference between the volatility of market prices and the variability of prices that farmers receive.

For a clearer vision of the evolution of prices and associated risks, we will present the evolution of prices for the period 2019-2022 for cereal and oilseed crops.

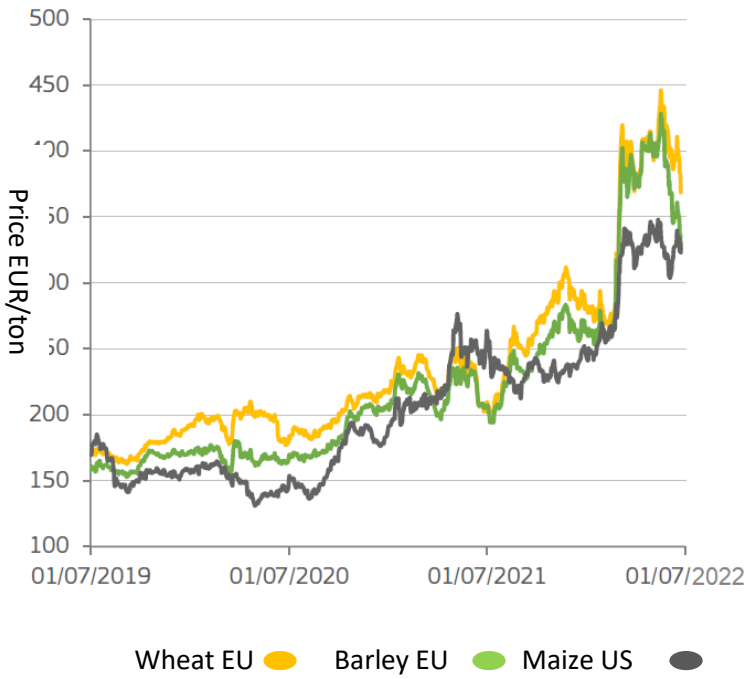


Figure 1: Evolution of grain export prices
Source: 471ad631-709b-4680-ace7-4cd4f05fffbe_en (europa.eu)

Figure 1 illustrates that at the beginning of 2022, grain prices reached a record high due to uncertainties surrounding global supply caused by the Russian invasion of Ukraine. The previous grain harvest faced significant export challenges through Black Sea ports, coupled with concerns about Ukraine's production levels. Many Ukrainian agricultural areas were impacted by military operations and the invasion's indirect effects. These factors exacerbated the existing upward trend in prices, which had been driven by post-COVID-19 demand for animal feed and high energy and fertilizer prices. Demand adjusted to these elevated price levels, and as the new harvest began in the Northern Hemisphere, prices started to decline

from their May 2022 peak. The primary risk to a successful harvest remains the persistent hot, dry weather affecting many parts of Europe. Global grain production in 2022-2023 is anticipated to be slightly lower than the record levels of the 2021-2022 season. Several factors are expected to reduce global grain trade: importers rationalizing purchases due to high prices, port blockades in Ukraine, and export restrictions imposed by certain countries.
Regarding oil prices, Figure 2 below shows the prices for rapeseed, soybeans, and sunflowers.

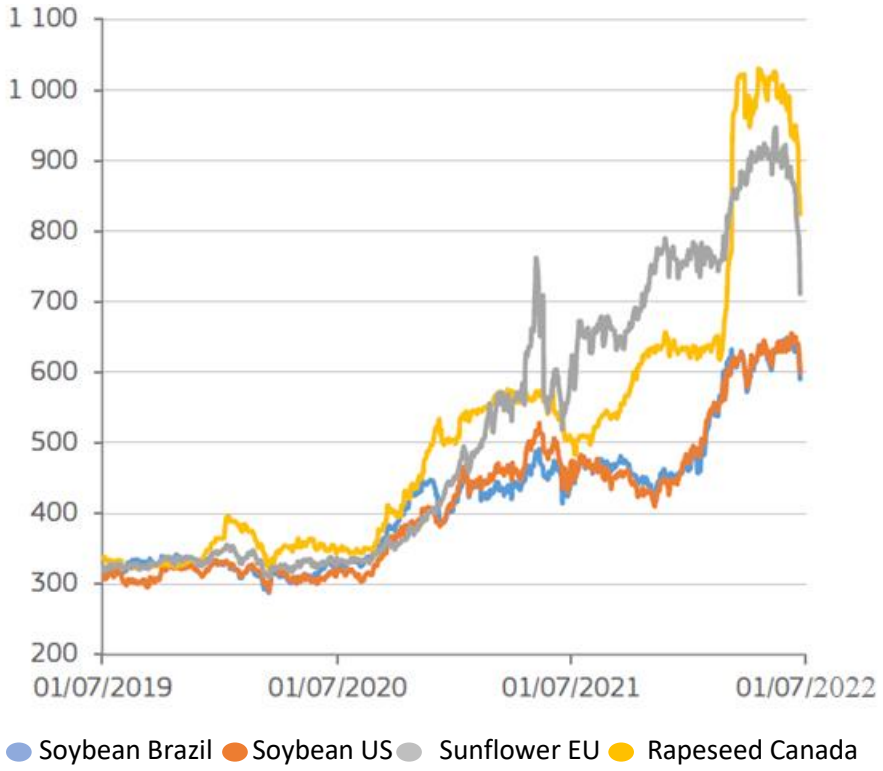


Figure 2: Evolution of export prices of oilseeds
Source: 471ad631-709b-4680-ace7-4cd4f05fffbe_en (europa.eu)

Over the past two years, oilseed prices have risen, peaking after the Russian invasion disrupted the supply of sunflower seeds and sunflower products on the global market. Recently, prices have decreased due to reduced demand and favorable production prospects in key regions.

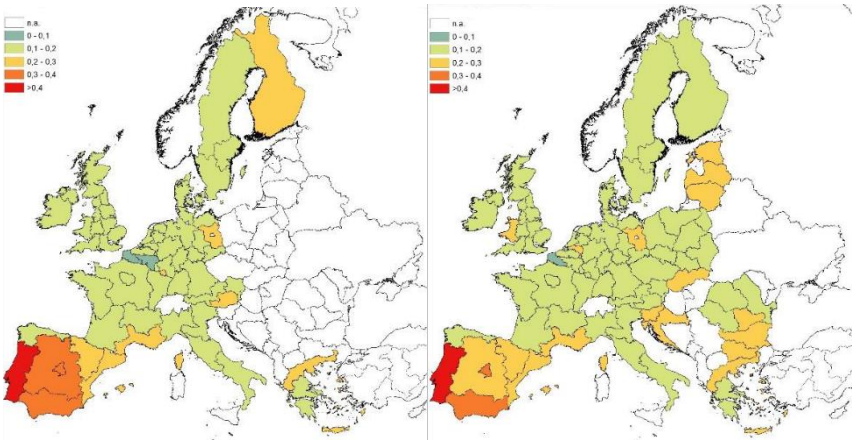
The sowing areas for sunflowers are increasing in 2022-2023, driven by high prices and a temporary exemption allowing crops to be planted on previously uncultivated land. Farmers have capitalized on this authorization, particularly for sunflowers, which require minimal water and fertilization. The estimated sunflower sowing area has reached 4.7 million hectares, an annual increase of 7.8%.

In the European Union, the cultivated area of rapeseed has also reached a four-year high of 5.7 million hectares. This increase is attributed to the already high prices during autumn 2021 sowing and favorable winter conditions for crop development. Similarly, the area sown with soybeans has grown by 8.6% annually, reaching 1 million hectares.

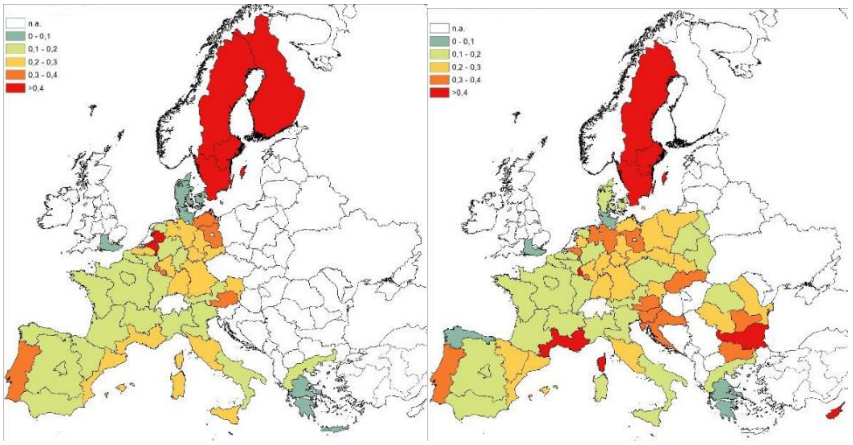
Agricultural Production: Risks from Animal and Plant Health Issues, Climate Change, and Environmental Factors

Production risk involves uncertainties affecting both the quantity and quality of goods produced. These uncertainties can stem from weather patterns, diseases and pests, and the use of various inputs like seeds, fertilizers, and pesticides. This section focuses on the variation in production for a specific crop category and presented regionally for two sub-periods, 2007-2013 and 2013-2021. Variability of production is related to the management of agricultural holdings, the environment and the events determined by climate change.

Wheat	2007-2013	2014-2021



Maize	2007-2013	2014-2021



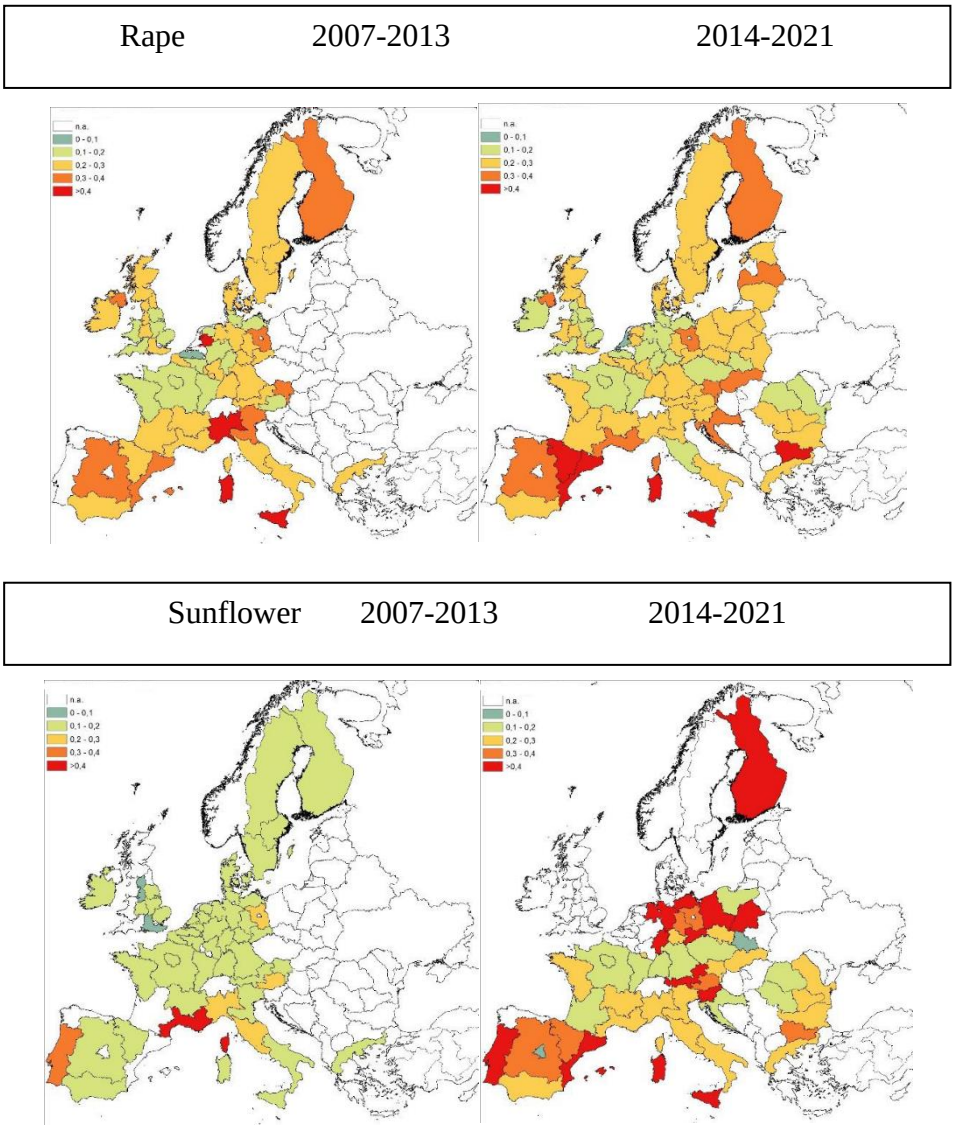


Figure 3: Evolution of production at EU level in cereals and oilseed crops
Source: made by the author based on data from Statistics | European Commission (europa.eu)2022

Figure 3 presents an overview of production risks, as measured by coefficient of variation (CV), for a selection of key arable crops. The global average coefficient of variation (CV) for manufacturing was 0.32 during 2007-2013 and 0.33 for 2014-2021. In comparison, the CV for crop prices was 0.36 and 0.39 for the same periods, respectively. This indicates that, on average, the price variation for arable crops is greater than the variation in production, consistent across both periods. Among the selected crops, oilseeds, especially sunflower, show the greatest variation in production. Certain regions are less suited for specific types of grain due to climatic conditions. For instance, wheat cultivation in the northern regions of the EU and in certain areas of Spain and Portugal faces challenges due to limited water availability. The relationship between production variation and weather factors (such as precipitation, heavy rains, and temperature) generally persists, though the extent of this relationship can be somewhat inferred from analyzing the correlation between crop production and climate variability indicators.
In specific regions of the European Union, production variation is notably different:

- The Mediterranean Peninsula (Spain, Portugal) experiences relatively high production variation compared to other regions.
- Other southern EU regions and northern areas also exhibit above-average production variability, likely due to climatic conditions and growing season differences.

It can also be seen that the variation in production also differs according to crops and products:

- Oilseeds such as rapeseed and sunflower show high yield variability while cereal variation is low compared to other types of crops.

Climate Risks and the Impact of Climate Change on Agricultural Production

Climate and the events generated by climate change represent one of the main risks related to agricultural production. Climate change is happening now and getting more intense as time goes on, even if the global effort to reduce greenhouse gas emissions is proving to be effective. But the impact will be less severe if the effort to reduce emissions succeeds in keeping the rise in global temperatures below 2 degrees Celsius, as stipulated in the Paris Agreement. Any scenario of increased emissions will lead to considerable climate change.

The risk profile on climate and climate change events covers the main risks related to agricultural production. Next, we will describe the main risks that influence agriculture: hail, precipitation and drought. Hail, which causes significant crop damage, is among the costliest weather events in European regions. Its frequent occurrence explains the high demand for crop insurance against this risk. However, mapping hail risk is challenging due to the limited number of observation stations and the unpredictable nature of hail based on surface data. Mohr and Kunz-Geyer (2015) analyzed European hail climatology from 1951 to 2010 using the Potential Hail Index (PHI), which measures the atmospheric potential for hail based on various meteorological parameters. The highest PHI values are recorded in regions north and south of the Alps, along the eastern side of the Adriatic Sea, and in certain parts of Eastern Europe. An increasing trend in hail occurrence has been observed in southern France and Spain, while a decreasing trend is noted in Eastern Europe. Future projections of hail events face significant uncertainties, as small-scale hail events are challenging to represent accurately in global and regional climate models. However, for Central Europe, model-based studies are helpful in estimating the frequency of hailstorms.

Extreme weather events such as heat waves, floods and drought will become more frequent and more intense in many regions. This aspect will have a negative impact on ecosystems, economic sectors and on the health and well-being of the population. In addition to the action to reduce greenhouse gas emissions, minimizing the risks generated by global climate change requires the adoption of specific actions, adaptable to the effects of climate change. These measures must be adapted to the specific circumstances of each region and city of Europe.

Drought was a recurring feature of the European climate. The severity and frequency of drought has increased especially in southwestern and central Europe. In most of Europe, throughout the 21st century, studies estimate significant increases in the duration, severity and frequency of drought, except for its northern area. Drought is a combination of individual indicators that includes the lack of precipitation, increased by high temperatures, associated with high evapotranspiration. By 2100, farms in southern Europe may experience significant drought-induced losses. The information can be easily seen in figure 10 below.

Figure 4 – Estimated drought climate changes at EU level
Source: Climate change impacts in Europe mobile version (arcgis.com)

Figure 4 above defines two scenarios influenced by the amount of CO2 emissions. The figure on the left considers an average emissions scenario and presents an estimate for the period 2041-2070 compared to 1981-2010. The figure on the right considers a high emissions scenario and presents an estimate for the period 2041-2070 compared to 1981-2010.

Precipitation patterns have changed since 1960, with increases of up to 70 millimeters per decade observed in northeastern and northwestern Europe, particularly during the winter season. Conversely, certain southern regions of Europe have experienced decreases of up to 90 millimeters per decade, especially during the hot season. In northern and northeastern Europe, the intensity of heavy precipitation has increased in both summer and winter. Meanwhile, indices for southwestern and southern Europe show varying trends.. Abundant precipitation is the main cause of floods and flood waves that cause major damage to agriculture. Climate change will lead to more rainfall in most areas of Europe, which will increase the risk of flooding.

Compared to the period 1971-2000, changes in the level of heavy rainfall during summer and winter are predicted during the period 2071-2100. Figure 11 below shows the changes in heavy rainfall during the period 2071-2100, compared to the present climate during the period 1971- 2000 based on the high emissions scenario. The largest increases in rainfall levels of up to 35% are present in Central and Eastern Europe. In the southern part, however, heavy rainfall increases of up to 25% can be recorded.

Winter Summer

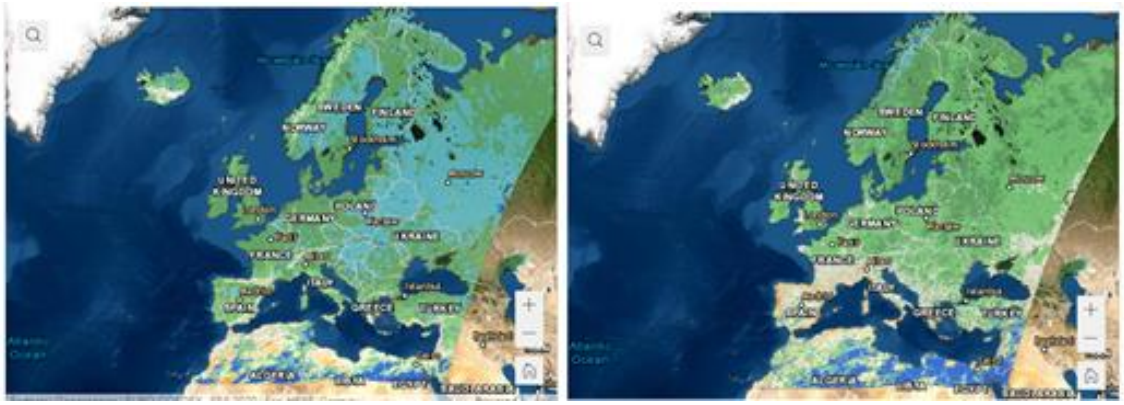


Figure 5: Evolution of precipitation at EU level
Source: Climate change impacts in Europe mobile version (arcgis.com)

Considering the climate risks discussed, the following points can be noted:

- **Drought Stress and Growing Season**: There is clear evidence of deteriorating agro climatic conditions in Central and Southern Europe, characterized by increased drought stress and a shorter growing season.
- **Extreme Weather Conditions**: Climate change poses a risk of more frequent extreme adverse weather events, which is likely to increase the variability of inter-annual crop production.

Financial, Institutional, Legal and Political Background

This section analyzes the impact of various Common Agricultural Policy (CAP) reforms on price, production, and income risks, though it is limited in scope. The extensive literature on CAP reforms and their underlying factors (Swinnen, 2008) is not summarized here. Instead, the focus is on reviewing CAP reforms from 1992 to 2027 and qualitatively assessing their main implications for the typical risks faced by farmers. It is important to acknowledge that changes in regulatory policies, such as environmental and trade policies, can also affect farmers' risks.

Table 1 below provides a qualitative assessment of how CAP reforms from 1992 to 2027 have specifically impacted agricultural market production and income risks. This partial analysis concentrates on the effects of CAP reforms on farm-level prices, production, and incomes. The general finding is that the MacSharry reform increased market and income risks, although its impact on production risk was relatively limited. This is mainly attributed to the shift from price support to direct payments, which increased market orientation and consequently expanded the range within which prices can fluctuate.

Table no. 1
CAP reform and the potential effect on market risk, output and income

Brief description of the main changes	Lowering price supports by compensating farmers for lost income through direct payments	Deepening of the 1992 reform: further reductions in price support (15% reduction) and increase in compensatory payments; the introduction of pillar 2 of the CAP and measures associated with rural development (RDP) - including measures to increase productivity and competitiveness);	Continuation of previous reforms; the introduction of the decoupled single payment scheme; Mandatory introduction of the notion of conformity. The RDP includes measures to increase productivity and competitiveness
Market (price) risk	Increasing volatility due to low price support	Increasing possibilities for price variation due to low price support (cereals).	Increasing possibilities for price variation due to low price support and reduction of the list of products eligible for public intervention.
Production risk	No direct impact; direct payments linked to historical production	No direct impact of pillar 1 measures; direct payments linked to historical production; pillar 2 measures seem to have had a positive impact on crop production but not on related risk	No direct impact was observed on crop risks from direct payments, which were decoupled from production. While these payments may have had a potential negative effect on crop production, they did not directly influence crop risks.
Farmers' income risk	The potential increase in variability arises from reduced price support and the greater impact of price fluctuations on farmer yields.	The potential increase in variability results from reduced price support for cereals and the heightened impact of price fluctuations on farmer yields.	Increased variability arises from reduced price support and the heightened impact of price fluctuations on farmers' yields. Direct payments, however, become a fixed

		Although direct payments provide a relatively stable income, they do not fully mitigate the increased variability in production and market conditions. component to farmers' incomes	component of farmers' income, providing a stable influence amidst this variability.

Source: European Commission, Directorate-General for Agriculture and Rural Development (2017). Study on risk management in EU Agriculture. Final Report - updated by the author

Table no. 1
Continuation

Brief description of the main changes	Additional flexibility regarding the implementation of direct payments; introduction of a gradual quota (1%/year); adjustments to the intervention system; the announcement of the expiry of the milk quota on March 31, 2014/2015; option to support risk management schemes.	Abolition of the milk quota and sugar reform in 2017; reforming direct payments and focusing them on ecological projects and special beneficiaries; risk management tools at RDP level, producer organizations, crisis reserves.	Policy reforms for sustainable agriculture and forestry. High focus on ecology and fairness(European Ecological Pact). Enhancing competitiveness: The new policy aims to strengthen farmers' position in the supply chain and boost the overall competitiveness of the agri-food sector.
Market (price) risk	There are no major changes compared to previous reforms. However, there are increased possibilities for price variability due to future restrictions on products eligible for public intervention.	There are no major changes relative to previous reforms.	No major changes; there could be price volatility due to the focus on green organic farming

Production risk	No direct impact; pillar 2 measures seem to have had a positive impact on crop yields but not on related risk.	No direct or limited impact on production variability	There could be an impact due to the focus on organic farming
Farmers' income risk	There are no semnificant changes compared to previous reforms	Reformed direct payments, as a fixed component of farmers' incomes, provide a stabilizing influence. In contrast, Member States have extensively utilized coupled support for certain sectors, which introduces greater variability compared to decoupled payments.	There are some changes to the definition of the active farmer who can benefit from EU support. In order to better respond to the income needs of smaller and medium-sized farms, EU countries will be required to allocate at least 10% of their direct payments to income redistribution support instruments.

Source: European Commission, Directorate-General for Agriculture and Rural Development (2017). Study on risk management in EU Agriculture. Final Report - updated by the author

The successive CAP reforms analyzed, which involved transitioning from price support to direct income support and safety nets, have led to increased market orientation. As a result, there is greater scope for price variability (market risk), which impacts farm income risk. Nonetheless, direct payments provide a stable and often significant component of farm income.

Conclusions

The analysis of risks in agriculture highlights the inherent complexities and uncertainties faced by farmers and the agricultural sector. Market risks, such as price volatility and supply-demand dynamics, can significantly impact agricultural profitability and market stability. Production risks, including weather patterns, diseases, and pests, pose challenges to crop yields and livestock health. Climate risks, driven by climate change, introduce additional uncertainties and vulnerabilities to agricultural systems. The financial, institutional, legal, and political context also plays a crucial role in shaping agricultural risks, with policy reforms and regulatory frameworks influencing market dynamics and income stability for farmers.

Managing risks in agriculture requires a comprehensive and integrated approach that considers multiple factors and stakeholders. This includes adopting risk management strategies that encompass market intelligence, production planning, climate resilience, and policy frameworks. Farmers and agricultural stakeholders need to stay informed about market trends, leverage technological advances, and implement sustainable practices to

mitigate risks and enhance the resilience of agricultural systems. Collaboration between farmers, policymakers, researchers, and industry experts is essential to develop effective risk management strategies and ensure the long-term sustainability of the agricultural sector.

Furthermore, addressing risks in agriculture goes beyond individual farm management. It requires collective efforts to promote sustainable agricultural practices, invest in research and innovation, and develop supportive policies and financial mechanisms. By fostering resilience and adaptive capacity, the agricultural sector can navigate the challenges posed by market fluctuations, climate change, and evolving regulatory landscapes. Ultimately, managing risks in agriculture is crucial for ensuring food security, economic stability, and environmental sustainability for present and future generations.

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