

From Field to Fork: five lessons from Southern Europe's Climate Change Response

A rise in extreme weather events continues to hit farmers, food companies and consumers across the globe. At the same time, climate change is driving structural changes in food production and consumption. Adaptation strategies for companies are crucial, and there are valuable lessons to be learned from what's happening in Southern Europe



Vineyards in the wine region of Penedès in Spain suffered this year due to severe drought in Catalonia

Strategic consequences for food manufacturers and distributors

Food and agriculture companies are under increasing pressure to adapt to the many challenges posed by climate change, as we wrote about [here](#). In this article, we spotlight Spain, Italy and Portugal as key case studies. These countries are major producers and exporters of everyday products like oranges, tomatoes, wine and olive oil, which find their way to the tables of consumers all across Europe. However, their status as leading suppliers is at risk. The European Environment Agency assesses that the risks from climate change to crop production are most

urgent and severe in Southern Europe. This shows that there is a lot at stake for farmers, food and beverage manufacturers and distributors in the region. But how companies in these countries adapt will also influence their competitors in other regions.

To identify long-term trends and shifts in production and consumption we use a range of databases on the production of six important crops in the region (wheat, wine grapes, olives, tomatoes, oranges and strawberries), production area, trade, household consumption and weather patterns. There are many lessons that we learn from this exercise. We consider the following five to be the most important since each of them comes with a strategic consequence for food manufacturers and distributors.

Lesson 1: Climate change, crop volatility and crop yields: it's not all doom and gloom

Long-term trend doesn't show more volatility for most crops

Larger fluctuations in production per hectare are a concern for farmers and food companies. Climate change acts as a catalyst for extreme weather events, which could lead to larger production swings. Agribusinesses have also expressed concern that stricter environmental regulations leave them with fewer options and tools, such as pesticides, to counter the impact of extreme weather going forward. However, our analysis for Spain, Italy and Portugal shows fluctuations in yields have not increased for most crops if you compare sets of years over a 50-year timespan. To us, this is a sign that, in general, farmers have been able to adapt their production systems thus far. In Spain and Italy, wheat is an exception with larger fluctuations due to a combination of bumper harvests and crop failures in recent years. For wine grapes, there was quite a drop in Spanish production in 2023, but in general wine grape yields are less volatile compared to the second half of the last century. Similar patterns can be observed in Portugal and Italy.

For most crops, fluctuations in yields have not increased in the past 50 years

Changes in the size of fluctuations in yields based on absolute deviation from the three-year average, 1966-2022

Crop	Spain	Italy	Portugal	
Common wheat	▲	▲	▶	▲ = size of fluctuations increased ▶ = size of fluctuations at similar level ▼ = size of fluctuations decreased
Durum wheat	▶	▼	▶	
Orange	▶	▼	▶	
Vineyard	▼	▼	▼	
Olive	▶	▼	▶	

Source: Eurostat, ING Research, *Portugal 1977-2022

Yields tend to go up in the EU but at the national level, trends can diverge

Historically, yields for most crops in Europe tend to improve as farms become more specialised and farmers introduce new technologies such as precision irrigation & fertigation and improved crop varieties. But particularly in Spain, 2022 and 2023 were bad years for crops like wheat,

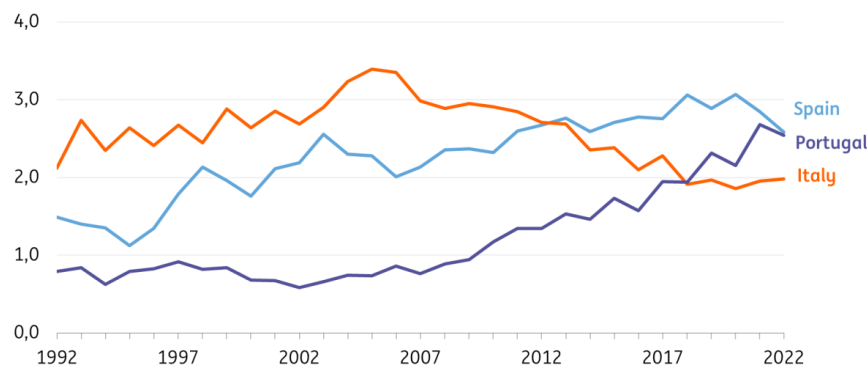
oranges and olives due to a prolonged drought. This has fostered concern among farmers about future crop yields, among food manufacturers and distributors about future supply, and among consumers about prices. The spike in olive oil prices is probably the most striking example.

Still between the late 1990s and 2022, yields for olive trees in Spain improved a lot thanks to improved production methods such as an increase in irrigated area, and the roll-out of super high-density farming. The same is true for Portugal since around 2008. However, yields per hectare in Italy have been on a downward trend for almost two decades, in part because many olive trees in Southern Italy have been severely affected by bacteria (*Xylella*) and water deficits.

But should the bad harvests in Spain in 2022 and 2023 be considered a 'one-off' or do they spell the end of a long-term trend? In our view, these two years show what climate change is capable of, but it is not necessarily the end of the long-term upward trend. Looking at harvest forecasts for the 2024/25 season, yields are expected to recoup some lost ground. Still, it will require constant investment to continue the upward trend.

Upward trend in olive tree yields in Spain and Portugal has stopped in recent years

Based on three-year moving average olive tree yields (tonne/hectare)



Source: Eurostat, ING Research

Extreme weather events put supply risks top of mind

The narrative about the impact of climate change on crop yields and the amount of volatility is quite nuanced. Yields do suffer from unfavourable weather in the short term. However, in the longer term, they tend to improve. And yes, there are fluctuations in yield at the national level if you compare individual years, but such fluctuations were also common in the past.

Still, extreme weather events are often regional and differences in yields between regions can be significant, especially in geographically diverse countries like Spain and Italy. The flooding in Emilia Romagna in 2023 which badly affected the region's fruit production is one example. Such events carry a direct supply risk for companies that mainly source from a certain area. On top of that, there is also a price risk for all companies when a regional shortfall leads to general shortages. Sourcing from multiple regions or having production facilities in multiple regions is a way to reduce such risks.

Lesson 2: Farmers do what they can to make their land climate-resilient

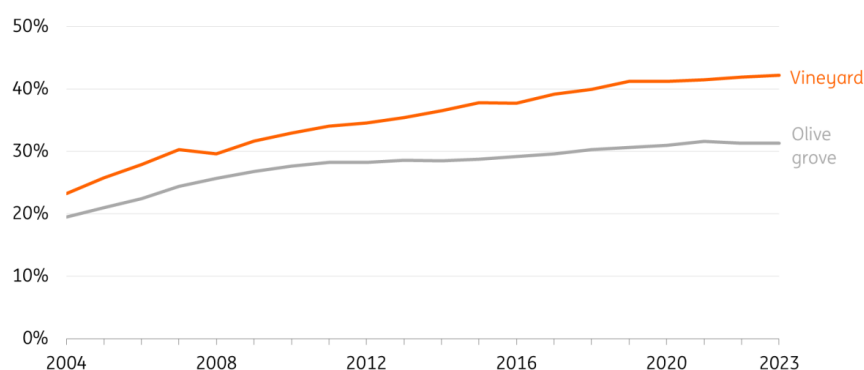
Irrigation as an adaptation strategy

In Southern Europe, in particular, measures to adapt to climate change often include irrigation or, in the case of tomatoes and strawberries, moving production from open fields to greenhouses. In the last 20 years, the proportion of irrigated area in Spain has increased for most of the crops in our analysis. Vineyards (+19%) and olive groves (+12%) have undergone the biggest increase in the proportion of irrigated land between 2004 and 2023.

For vineyards, 60% of the increase in the irrigated area comes from Castilla-La Mancha, which is one of the most important production regions. The proportion of irrigated vineyards in this region has almost doubled, from 28% to 52%. In La Rioja and Castilla y León, probably the most iconic wine regions (with Rioja and Ribera del Duero wines), the irrigated area has also increased by around 20%. The rise of irrigated area dedicated to olives in Spain has been driven mainly by Andalucía and Extremadura, amounting to 65% and 15% of the total expansion, respectively. While in Andalucía, producers started to introduce irrigation a long time ago, in Extremadura the process has been more intense in the last few years.

Clear increase in irrigated area for wine grapes and olives

Proportion of Spanish vineyards and olive groves that are irrigated



Source: Spanish Ministry of Agriculture and Fisheries; ESYRCE, ING Research

Irrigation boosts production but by itself, it's not a solution to water issues

For both vineyards and olive groves, the proliferation of irrigation has significantly boosted productivity in the last few decades. Since the strong increase in irrigation that started in the '90s, Spanish yields for olives and wine grapes have approximately doubled. More and better irrigation can offer a solution for farmers in certain areas, but by itself, it often fails to solve the long-term problems around water scarcity. That's partly because technologies that promote more efficient ways to use a resource like water come with a 'rebound effect'. Such technologies lower the cost of the resource which enables companies to expand irrigation to more land rather than reduce overall water consumption. The agricultural sector is a key factor in total consumption since it accounts for almost 80% of the total water use in the country.

Support from food companies is needed given the increased risks that farmers face

Food manufacturers and distributors are likely to favour sourcing from those farms that are best able to adapt (often the bigger farms) to reduce supply risks. However many farmers struggle to adapt because they lack the means. In the longer term, this can pose a supply risk for manufacturers and distributors. Becoming more involved in the challenges at the farm level leads to a more resilient value chain but it comes with obligations. Involvement can be through R&D into better crop varieties and farming practices, offering more security in contracts or by promoting more sustainable water management practices. Securing the backing from large customers like retailers is also crucial to distributing the risks and costs throughout the value chain.

Lesson 3: Heat and drought push some production to more suitable areas

Structural shifts in crop areas

In Spain, the main crop production regions of the past continue to dominate in the present. But some parts have become less favourable due to climate conditions and reduced water availability. So within these regions we notice the following shifts:

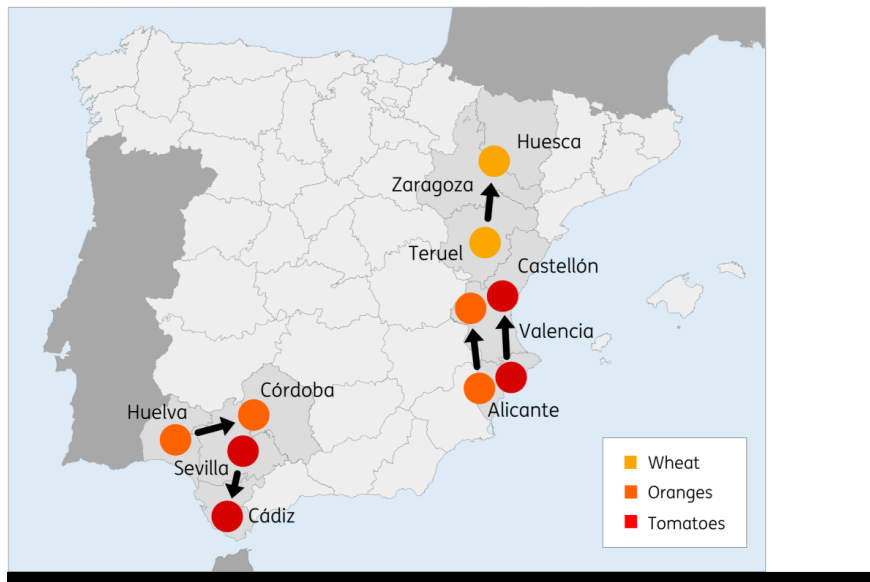
- **Wheat:** in Aragon (which is one of the main regions for wheat) the focus for both common and durum wheat production is moving towards its northern provinces as the south of the region is heavily affected by drought.
- **Tomatoes:** Andalusia is the heartland of tomato production and within Andalusia, the area devoted to tomatoes is shifting from Seville to Cadiz due to limited water for irrigation in the Guadalquivir basin. Meanwhile in the Valencian Community ('Comunidad Valenciana') there is a shift in area from Alicante to the northern provinces of Valencia and Castellon.
- **Oranges:** for many the region around Valencia is synonymous with oranges. Within the 'Comunidad Valenciana' the province of Alicante has been losing almost 50% of its production area in the past 20 years. This means that the geographic focus for orange production has shifted even more towards the province of Valencia. A similar pattern takes place in Andalusia, with a decrease in Huelva and an increase in the regions of Seville and Cordoba.
- **Wine grapes:** In Spanish wine regions it's harder to distinguish shifts that directly link to climate change. In Castile and Leon, some area has moved from Zamora (Toro) to Valladolid and Burgos (Ribera del Duero). The increased popularity for the latter could also be a driver for the trend. In Italy, we notice a broader movement from south to north. Veneto has driven the upward trend in the north while the total production area in southern regions like Puglia and Sicily has been falling steadily over the last 20 years.
- **Tropical fruit:** the growing presence of tropical fruit like mango and avocado in Spain and Italy is another example of a change in crop area which is supported by climate change (especially milder winters). More favourable weather is not the only factor, as growth is also driven by increased demand and better financial returns for such products compared to other fruit.

While moving cropland to more favourable locations makes sense at a company level, it potentially also relocates problems such as water scarcity rather than addressing the root causes of the problem, especially considering that climate change is an ongoing process. When farming areas that were once fertile and productive become abandoned it is also up to actors in the food

value chain and policymakers to ensure that there are also long-term solutions to regenerate land and ecosystems as this will help combat climate change.

The production area of these crops has partially shifted to more suitable areas

Direction of crop movement across provinces in the last 20 years



Source: Spanish Ministry of Agriculture and Fisheries: ESYRCE, ING Research

Food companies reconsider whether production facilities and warehouses are still in the right place

The observed movements in crop areas are quite gradual, but they can carry implications for manufacturers and distributors, especially when they heavily depend on the proximity of supply like in tomato processing. Deteriorating conditions in some regions can be a reason for these companies to reassess if processing plants and warehouses are still in the right location in 5 to 10 years from now. While we focused our analysis on moves within Spain we have also noticed interest from Spanish companies to invest in land or production abroad (Portugal, North Africa, Latin America).

Lesson 4: Imports serve as a backup when extreme weather hits domestic supply

Reducing supply gaps

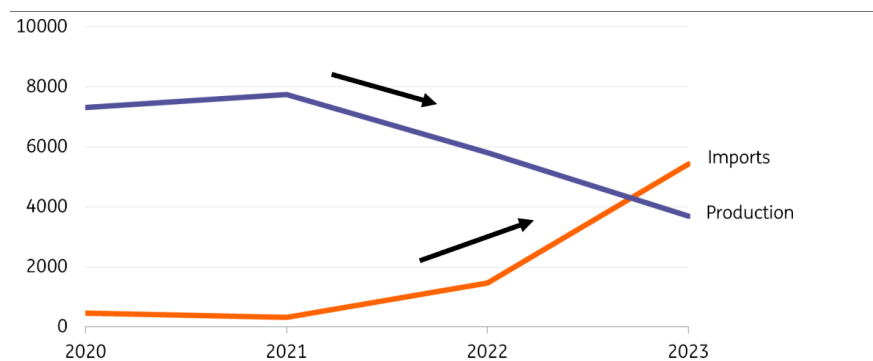
Improving irrigation and shifts in crop areas towards more suitable locations are mid- to long-term adaptation strategies. However, food processors and distributors also have to deal with unfavourable weather events that can reduce supply at short notice. For crops and agricultural products, one of the most common strategies is to turn to imports to reduce the gap between the anticipated and the actual supply.

The case of wheat in Spain illustrates this point quite well, particularly after the shortfall in

production in 2022 and 2023 that happened due to heat waves, drought and the strong increase in costs of inputs like diesel and fertiliser. The graph below clearly depicts how imports increase following a bad year in terms of production. In other words, to cope with demand, in 2022 and 2023 companies switched to imports due to sharp drops in total production (25% and 36%, respectively).

Imports made up for the drop in Spanish wheat production in 2022 and 2023

Annual common wheat production and import volumes in Spain



Source: Eurostat, European Commission: Weekly Taxud imports, ING Research

Incorporating more imports does come with operational challenges

When companies have strong alternative supply networks this will alleviate some of the impact for processors, retailers and consumers. Incorporating more imported products can still create operational challenges for food manufacturers since imported products need to meet EU standards, and products often also need to meet certain specifications (such as size, colour or taste). Passing on any additional costs into their selling prices is another operational challenge.

Lesson 5: Rising temperatures change consumption patterns

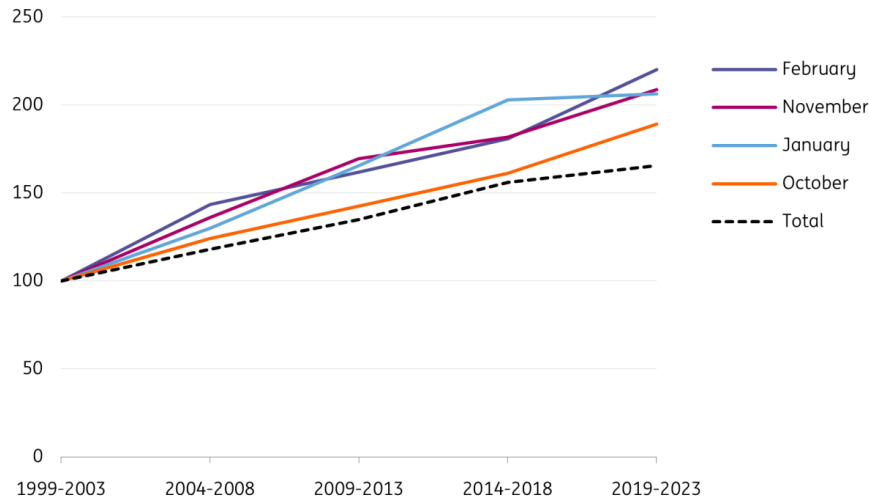
Soup and ice cream consumption affected by climate change

The effect of climate change on consumption patterns is most pronounced for 'seasonal' products such as soup and ice cream. Monthly data on Spanish household consumption over the last 25 years shows a clear decline in soup consumption per capita and an increase in ice cream consumption. Rising temperatures are part of the explanation. When we combine data on consumption with data on average monthly temperatures, it shows that the drop in soup consumption is most pronounced when the temperature in a certain month is much higher than the long-term average for the same month. Meanwhile, for ice cream consumption it is positive when months are hotter than usual.

We also observe shifts in how much households consume each month. While ice cream consumption has increased in every month, typically colder months such as February and November, show the strongest growth rates. Therefore, as temperatures are expected to keep rising, distributors could expect to see demand grow as the ice cream season lengthens further.

The relative increase in ice cream consumption in Spain is more pronounced in colder months

Ice cream consumption, five-year average (Index, 1999-2003 = 100)



Source: Spanish Ministry of Agriculture and Fisheries, ING Research

Opposite trends for beer and wine

Regarding beverages, it is particularly interesting how consumption patterns have changed for beer and wine (often considered substitutes). On the one side wine consumption (at home) has decreased by approximately 35% in the last 20-25 years. This trend has been more pronounced in the summer months, with a close to 40% decline. On the other side, at-home consumption of beer has expanded (+60%) over the past 25 years. But growth has been especially strong during the colder months (+75% in winter months). The reason behind this pattern is that red wine, in particular, is traditionally associated with colder seasons and, as winters become warmer, it gradually loses popularity in comparison to beer. While we do find a clear link with temperatures, other factors are also influencing the trend. Within the beverage category, consumer preferences tend to shift over generations, and the introduction of more non-alcoholic beers is attracting new buyers to the category.

Also, it's good to keep in mind that the consumption data we used has some limitations: it only covers at-home consumption (while the majority of beer consumption is outside the home) and it disregards consumption from an ever-increasing number of tourists.

Changing demand for beverages, ice cream and soup could push food makers into rethinking their product portfolio

Temperature increases will continue to shape consumption patterns of certain products. Some producers and distributors will look for alternatives to prevent losses in revenues and will consider actions to make their product portfolio more 'climate proof'. At the same time, it can be a growth driver for other products. However, growth is not evenly distributed throughout the year and periods with extreme temperatures are tricky to predict. So besides models that forecast demand,

producers and distributors also need a certain level of flexibility to be able to cater to additional demand on short notice.

Conclusion: five lessons that provide a starting point for a strategic discussion on climate adaptation

When looking at the impact of climate change on food production in Spain, Italy and Portugal it is clear that there are risks for agriculture and food manufacturing, especially when farmers are not able to adapt. However, these changes also create opportunities for innovation and opportunities for companies to tap into changing consumption patterns.

The five lessons in this article illustrate how the impact of global warming leads to structural changes in food production and consumption. By highlighting five strategic consequences, we aim to provide a starting point for large food companies to engage in an integral discussion about how an effective climate adaptation strategy should look. Given the structural changes that we observe, we believe such a strategy is essential for food companies in Southern Europe and other countries, too.

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