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European Commission

Science for Environment Policy

The economic impact of climate change on European agriculture

A new study has estimated how changes to climate might affect the value of European farmland. Based on data for over 41 000 farms, the results suggest that their economic value could drop by up to 32%, depending on the climate scenario considered. Farms in southern Europe are particularly sensitive to climate change and could suffer value losses of up to 9% per 1 °C rise. The researchers say policy, on water and land use, for example, will be crucial to help farmers adapt to climate change and mitigate economic losses.

Agriculture is extremely vulnerable to climate change, as farming depends directly on weather conditions, such as rainfall and temperature. The economic implications for farmers could be huge.

This study estimated these effects in Europe. Importantly, it used farm-level data rather than crop models (which describe how climate affects specific crops, but omit impacts to livestock and underestimate the ability of farmers to adapt). The data, obtained from the Farm Accountancy Data Network (FADN)[1], contain information from 2007 on over 41 000 farms across Europe[2] (this data set only covers the EU-15).

The EU-funded[3] researchers matched climate, soil, geography and regional socio-economic variables with the farm-level data using 'Ricardian analysis'. This is a statistical method that estimates the relationship between the value of agricultural land and climate. The Ricardian method considers the productivity of land (its annual net revenue) and accounts for the direct effect of climate on crops and how climate affects the choices of farmers (such as which crop or livestock to farm).

The method reflects both small and large changes in temperature and precipitation based on a range of climate predictions for 2100, predicted by three General Circulation Models: Hadley CM3, ECHO-G and NCAR PCM, based on the IPCC Special Report on Emissions Scenarios A2 scenario. The models represent severe, moderate and mild outcomes, respectively.

The researchers also accounted for the effect of policy, which could exacerbate climate sensitivities if, for example, subsidies are higher for farms in favourable climates. The analysis therefore controls for subsidies at the farm level and removes the influence of country-level policies.

The researchers estimated the impact of seasonal temperature and precipitation on farmland value across the countries considered by calculating the percentage change in farmland value per 1 °C for temperature and per centimetre per month (cm/month) for rainfall. Overall, farms that are warmer in the autumn and spring, and cooler in the summer and winter, tend to have higher values. This is because a colder winter limits pests and a warmer spring/autumn lengthens the growing season. A warmer summer places adverse stress on crops.

Rainfall also significantly affected the value of farmland. Analysis showed that farms that are wetter in the winter and summer, but drier in the spring and autumn, tend to benefit. This is because there is already sufficient rainfall in the spring and autumn, and more rainfall signifies more cloud, which blocks energy from the sun used by plants for photosynthesis — and thus crop growth. It is also likely that excessive rainfall causes more direct harm, such as water clogging in spring and mildew problems near harvesting. By contrast, extra rainfall in summer can help compensate for the heat and more rainfall in winter provides soil moisture for the start of the growing season.

Continued on next page.

1. The FADN is run by the Directorate General for Agriculture and Rural Development. Its data are collected on an annual basis to evaluate the income of agricultural holdings and the impacts of the Common Agricultural Policy.

2. The figure of 41 000 is the sample taken for this study, as the annual sample of the entire FADN network currently covers approximately 80.000 holdings: http://ec.europa.eu/agriculture/rica/concept_en.cfm

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Under the model, an increase of 1 °C across all farms by 2100 would increase farmland value by 8.2% (€482 per hectare), while an increase in rainfall of 1 cm/month would increase value by 2.4% (€143 per hectare). The effects of these changes differ widely between countries, however. Small increases in temperature are harmful in southern Europe, for example, but beneficial in northern Europe. Similarly, a small increase in rainfall would benefit most European countries, but not those in Scandinavia.

Impacts predicted by the climate models ranged from a 5% gain (NCAR PCM) to a 32% loss (Hadley CM3). Overall, the changes predicted by the climate scenarios would be harmful to agriculture in Europe. Across all the models, the impact appears to be more severe in southern Europe (which was adversely affected in all cases[4]). Italy showed the largest loss of value, losing €120 billion (71%) of its farmland value in the Hadley CM3 scenario. Using the two milder climate scenarios, though, some countries in northern Europe appear to benefit from climate change. Even within regions, the effect is not uniform. In Finland, for example, agriculture benefits from warming in some seasons but is overall harmed by rising winter temperatures.

The researchers suggest that policy could have a large impact on these future scenarios. Governments can support the development of new technologies, crops and breeds. They are also responsible for regulating water (a major agricultural input) and how land can be used. Changes in government policy in these areas could, therefore, help farmers adapt to climate change and avoid major losses.

3. The researchers received funding through a Marie Curie Fellowship 'Climate Change Impacts – Economic Modelling and Assessment', supported by the European Commission under its Seventh Framework Programme. See: http://cordis.europa.eu/project/rcn/98977_en.html

4. In the models, an increase in temperature usually accompanies a decrease in rainfall or more severe weather events.