

European grain yield stagnation related to climate change, says researcher

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The European Union led the world in wheat production and exports in 2014-15. Yet Europe is also the region where productivity has slowed the most. Yields of major crops have not increased as much as would be expected over the past 20 years, based on past productivity increases and innovations in agriculture.

Finding the causes of that stagnation is key to understanding the trajectory of the [global food supply](#).

Logically, it would seem that climate change would affect crops. But in the overall picture of [agriculture](#), it's hard to figure out how much. European farming is a complex venture, and other possible stagnating factors include changes in [government policy](#). For example, farm subsidies are no longer based on productivity and the use of fertilizer is now controlled to reduce runoff into water supplies. Ongoing positive factors include improvements in farm management practices and advances in crop genetics.

Historically, scientists relied on models to estimate the effects of climate change. Now Stanford's Frances C. Moore has for the first time statistically quantified the relative importance of climate in the stagnation of European crops. She found that warming and precipitation trends are affecting European grain harvests. Moore is a PhD candidate in the Emmett Interdisciplinary Program in Environment and Resources.

"This study is sobering in that it shows climate drags on some of the crops in this region," said David Lobell, co-author of the paper. "Yet this new approach to looking at the problem will help us understand more quickly what impacts require more attention, and that can only be positive in the long term." Lobell is an associate professor of environmental Earth system science and the deputy director of the Center on Food Security and the Environment at Stanford. He is also a senior fellow in the Freeman Spogli Institute for International Studies and the Stanford Woods Institute for the Environment. He studies ways to improve crop yields in major agricultural regions, with emphasis on adaptation to climate change.

"This is a major step in using quantitative analysis to disentangle the effect of climate change in a complicated system," said Dáithí Stone, a

pioneer in comparing actual seasonal weather forecasts with what those forecasts would have been if human activities had not emitted greenhouse gases. "It demonstrates that the signal has become large enough that we may see the effect of [climate change](#) in a complicated system like agriculture." Stone is a research scientist in the Computational Chemistry, Materials and Climate Group of Berkeley Lab.

How wheat and corn and barley grow

Moore considered two factors in the study: actual crop yields and expected [crop yields](#) given historic temperature and precipitation trends. She applied statistical analyses to look for patterns in regional maps of actual European yields of wheat, maize (known in the United States as corn), barley and sugar beets, from 1989 to 2009.

The study found that climate trends can explain 10 percent of the slowdown in wheat and barley yields, with changes in government policy and agriculture likely responsible for the remainder of the stagnation. Moore found evidence that long-term temperature and precipitation trends since 1989 reduced overall European yields of wheat by 2.5 percent and barley by 3.8 percent, while slightly increasing maize and sugar beet yields.

Moore also wanted to find out to what extent farmers had adapted their practices to accommodate changing conditions. She applied power analysis, a statistical tool to test the effect of adaptation. But she discovered the test was not effective in the context of this study.

"We think farmers have been hurt already by warming and drying trends in Italy," Moore said. Undaunted by the limits of statistical analysis to measure farmer adaptation, she is planning another way to find out. "I have been doing this work in front of a computer – in the future I would

like to go to Italy," she said. "It would be interesting to talk to the farmers."

More information: "The fingerprint of climate trends on European crop yields." *PNAS* 2015 ; published ahead of print February 17, 2015, [DOI: 10.1073/pnas.1409606112](https://doi.org/10.1073/pnas.1409606112)

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