

Climate change curbs crops

Warming has already lowered yields of wheat and corn.

[Nicola Jones](#)



Global climate change is affecting the yields of crops like corn already, much sooner than expected. *PIXFOLIO / Alamy*

Farmers have produced less food during the past three decades than they would have done were climate change not happening, according to a study published today¹. Global maize (corn) production, for example, is estimated to be about 3.8% lower than it would have been in a non-warmed world — the equivalent of Mexico not contributing to the maize market.

"These things are happening now," emphasizes David Lobell, an Earth system scientist at Stanford University in California and a co-author on the study.

The results come as a surprise to many. "I've been operating under the assumption we wouldn't be able to detect changes until the 20s or 30s of this century," says Gerald Nelson, an agricultural economist with the International Food Policy Research Institute in Washington DC, who was not involved with the work.

National crop yields are still rising as a general trend. But the fact that they are lower than a theoretical maximum is important when considering the huge challenge of feeding the world's booming population, the authors say.

Bigger changes may lie ahead. The study notes that the United States — which produces about 40% of the world's soya and maize — has so far been shielded from yield declines because its crop-growing regions haven't warmed in summer over the past 30 years, perhaps because of natural variability or the cooling counter-effect of aerosols. "There has been a perception that a perfect storm of conditions led to higher food prices in recent years. But that wasn't the case at all, because this major producer wasn't being detrimentally affected," says Lobell. "The US may have been lulled into a sense of complacency."

The study also shows that temperature has so far had a much greater effect on crop yields than precipitation. So it might be more important to breed heat tolerance into future generations of crops than to make them capable of surviving with less water.

Unpicking a trend

Crop yields depend on many things, from the vagaries of the market to the price of fertilizer and the availability of new technologies. However, the authors assumed that most of these factors are not linked to the weather, making it possible to extract a model of how temperature and precipitation is linked to national yields. Although warm temperatures can extend growing seasons, excessive heat generally restricts crop growth, and promotes pests and water loss. Additional rainfall, meanwhile, is beneficial up to a point.

The authors used their modelling results to estimate the effect that temperature and rainfall trends had on each nation's food production from 1980 to 2008.

They estimate that, despite the fertilizing effect of increased carbon dioxide in the atmosphere, the negative effect of climate change on plant growth has cut wheat production by 2.5%, but boosted that of rice by 2.9% and soya beans by 1.3%. It has also, they calculate, bumped up food commodity prices worldwide by about 6.4% over 30 years.

The authors admit that their results are packed full of assumptions. They could be overestimating climate's effects, because the model doesn't account for the fact that farmers might switch to different crop varieties or change their planting dates as conditions change. Conversely, the results could be an underestimate, given that the model doesn't look specifically at extreme weather events such as droughts, floods and heatwaves. "It's the best we can do with the data available," says Lobell.

Sooner than expected

The general result of about a 5% yield loss per degree Celsius of warming is consistent with previous studies, says Lobell. But the authors' conclusions differ from previous work in a few important ways.

A study published by *Nature* in 1994² concluded that the fertilizing effect of carbon dioxide would probably counteract the negative effects of warming at low latitudes for a few decades to come. "We don't see that," says Lobell.

That same study also concluded that warming would hit food production in developing countries harder than in the developed world, because many richer nations are in colder climates that might benefit from warming, and are probably more adaptable to changing conditions. But Lobell *et al.* don't see this happening either. Instead, Lobell guesses, the relatively high production per unit area in the developed world means that developed countries are actually more susceptible to the vagaries of the weather. Poorer nations, on the other hand, have a low production rate and are as much affected by other factors, such as the availability of fertilizer.

The results should add impetus for developed nations to take the effects of climate change on food production seriously, Lobell says. "Adaptation isn't something for down the line, it's something we need right now." The United States may already have made a start: in

February, the US Department of Agriculture invested \$60 million in three studies on the effects of climate change on crops and forests.

- **References**

1. Lobell, D. B., Schlenker, W. & Costa-Roberts, J. *Science* doi:10.1126/science.1204531 (2011).
2. Rosenzweig, C. & Parry, M. L. *Nature* **367**, 133-138 (1994). | [Article](#) | [ISI](#) |