

# Toll of climate change on world food supply could be worse than thought

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Global agriculture, already predicted to be stressed by climate change in coming decades, could go into steep, unanticipated declines in some regions due to complications that scientists have so far inadequately considered, say three new scientific reports.

The authors say that progressive changes predicted to stem from 1- to 5-degree C temperature rises in coming decades fail to account for seasonal extremes of heat, drought or rain, multiplier effects of spreading diseases or weeds, and other ecological upsets. All are believed more likely in the future. Coauthored by leading researchers from Europe, North America and Australia, they appear in this week's issue of the *Proceedings of the National Academy of Sciences*.

“Many people assume that we will never have a problem with food production on a global scale. But there is a strong potential for negative surprises,” said Francesco Tubiello, a physicist and agricultural expert at the NASA/Goddard Institute of Space Studies who coauthored all three papers. Goddard is a member of Columbia University's Earth Institute.

In order to keep pace with population growth, current production of grain—from which humans derive two-thirds of their protein—will probably have to double, to 4 billion tons a years before 2100. Studies in the past 10 years suggest that mounting levels of carbon dioxide in the air—believed to be the basis of human-caused climate change—may initially bolster the photosynthetic rate of many plants, and, along with new farming techniques, possibly add to some crop yields. Between now

and mid-century, higher temperatures in northerly latitudes will probably also expand lands available for farming, and bring longer growing seasons. However, these gains likely will be canceled by agricultural declines in the tropics, where even modest 1- to 2-degree rises are expected to evaporate rainfall and push staple crops over their survival thresholds. Existing research estimates that developing countries may lose 135 million hectares (334 million acres) of prime farm land in the next 50 years. After mid-century, continuing temperature rises—5 degrees C or more by then—are expected to start adversely affecting northern crops as well, tipping the whole world into a danger zone.

The authors of the PNAS studies say that much of the previous work is oversimplified, and as a consequence, the potential for bigger, more rapid problems remains largely unexplored. “The projections show a smooth curve, but a smooth curve has never happened in human history,” said Tubiello. “Things happen suddenly, and then you can’t respond to them.” For instance, extreme-weather events of all kinds, including heat waves or sudden big storms, could easily wipe out crops on vast scales if they occur for even a few days during critical germination or flowering times. Tubiello says this is already happening on smaller scales. During a heat wave in the summer of 2003, temperatures in Italy soared 6 degrees C over their long-term mean, and the corn yield in the rich Po valley dropped a record 36%. Nearly all the world’s pastures are rain-fed; in Africa, droughts in the 1980s and 1990s wiped out 20% to 60% of some nations’ herds. Such events on larger scales could arise with little or no warning in the near future, the authors suggest.

Higher temperatures may also prompt outbreaks of weeds and pests, and affect plant or animal physiology—factors also left out of most projections. One of the new PNAS studies, “Crop and Pasture Response to Climate Change,” says that more recent modeling suggests cattle ticks and bluetongue (a viral disease of sheep and cattle) will move outward

from the tropics to areas such as southern Australia. Other new models suggest that higher temperatures will limit the ability of modern dairy-cow breeds to convert feed into milk, and lead to declines in livestock fertility and longevity. As temperatures rise in northerly latitudes, the ability of crop pests to survive winters is expected to improve, enabling them to attack spring crops in regions where they were previously kept at bay during this vulnerable time.

The authors say that farmers may temporarily mitigate some effects of changing climate by moving toward adaptations now. Adaptations already being considered or set up include regional climate-forecasting systems that enable farmers to switch to different crops or change the timing of plantings; introduction of new varieties or species that can withstand anticipated conditions; and improved flood-mitigation and water-storage facilities. One of the PNAS studies, “Adapting Agriculture to Climate Change,” says that such adaptations might help tropical farmers cut damages wrought by rises of 1.5 to 3 degrees, and temperate-region farmers, damages from 1- to 2-degree rises. This would buy a few decades of time for nations to agree on ways to slow or reverse the warming itself. “After that, all the bets are off,” said Tubiello.

Source: The Earth Institute at Columbia University

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