Untapped crop data from Africa predicts corn peril if temperatures rise

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This is an experimental maize field managed by CIMMYT in Kiboko, Kenya. Credit: Photo by David Lobell, Stanford University

A hidden trove of historical crop yield data from Africa shows that corn – long believed to tolerate hot temperatures – is a likely victim of global warming.

Stanford agricultural scientist David Lobell and researchers at the International Maize and Wheat Improvement Center (CIMMYT) report in the inaugural issue of *Nature Climate Change* next week that a clear negative effect of warming on maize – or corn – production was evident in experimental crop trial data conducted in Africa by the organization and its partners from 1999 to 2007.

Led by Lobell, the researchers combined data from 20,000 trials in sub-Saharan Africa with weather data recorded at stations scattered across the region. They found that a temperature rise of a single degree Celsius would cause yield losses for 65 percent of the present maize-growing region in Africa – provided the crops received the optimal amount of rainfall. Under drought conditions, the entire maize-growing region would suffer yield losses, with more than 75 percent of areas predicted to decline by at least 20 percent for 1 degree Celsius of warming.

"The pronounced effect of heat on maize was surprising because we assumed maize to be among the more heat-tolerant crops," said Marianne Banziger, co-author of the study and deputy director general for research at CIMMYT.

"Essentially, the longer a maize crop is exposed to temperatures above 30 C, or 86 F, the more the yield declines," she said. "The effect is even larger if drought and heat come together, which is expected to happen more frequently with climate change in Africa, Asia or Central America, and will pose an added challenge to meeting the increasing demand for staple crops on our planet."

Similar sources of information elsewhere in the developing world could improve crop forecasting for other vast regions where data has been lacking, according to Lobell, who is lead author of the paper describing the study.

"Projections of climate change impacts on food production have been hampered by not knowing exactly how crops fair when it gets hot," Lobell said. "This study helps to clear that issue up, at least for one important crop."

While the crop trials have been run for many years throughout Africa, to identify promising varieties for release to farmers, nobody had

previously examined the weather at the trial sites and studied the effect of weather on the yields, said Lobell, who is an assistant professor of environmental Earth system science.

"These trials were organized for completely different purposes than studying the effect of climate change on the crops," he said. "They had a much shorter term goal, which was to get the overall best-performing strains into the hands of farmers growing maize under a broad range of conditions."

The data recorded at the yield testing sites did not include weather information. Instead, the researchers used data gathered from weather stations all over sub-Saharan Africa. Although the stations were operated by different organizations, all data collection was organized by the World Meteorological Organization, so the methods used were consistent.

Lobell then took the available weather data and interpolated between recording stations to infer what the weather would have been like at the test sites. By merging the weather and crop data, the researchers could examine climate impacts.

"It was like sending two friends on a blind date – we weren't sure how it would go, but they really hit it off," Lobell said.

Previously, most research on climate change impacts on agriculture has had to rely on crop data from studies in the temperate regions of North America and Europe, which has been a problem.

"When you take a model that has been developed with data from one kind of environment, such as a temperate climate, and apply it to the rest of the world, there are lots of things that can go wrong" Lobell said, noting that much of the developing world lies in tropical or subtropical

climates.

But he said many of the larger countries in the developing world, such as India, China and Brazil, which encompass a wide range of climates, are running yield testing programs that could be a source of comparable data. Private agribusiness companies are also increasingly doing crop testing in the tropics.

"We're hoping that with this clear demonstration of the value of this kind of data for assessing climate impacts on crops that others will either share or take a closer look themselves at their data for various crops," Lobell said.

"I think we may just be scratching the surface of what can be achieved by combining existing knowledge and data from the climate and agriculture communities. Hopefully this will help catalyze some more effort in this area."

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