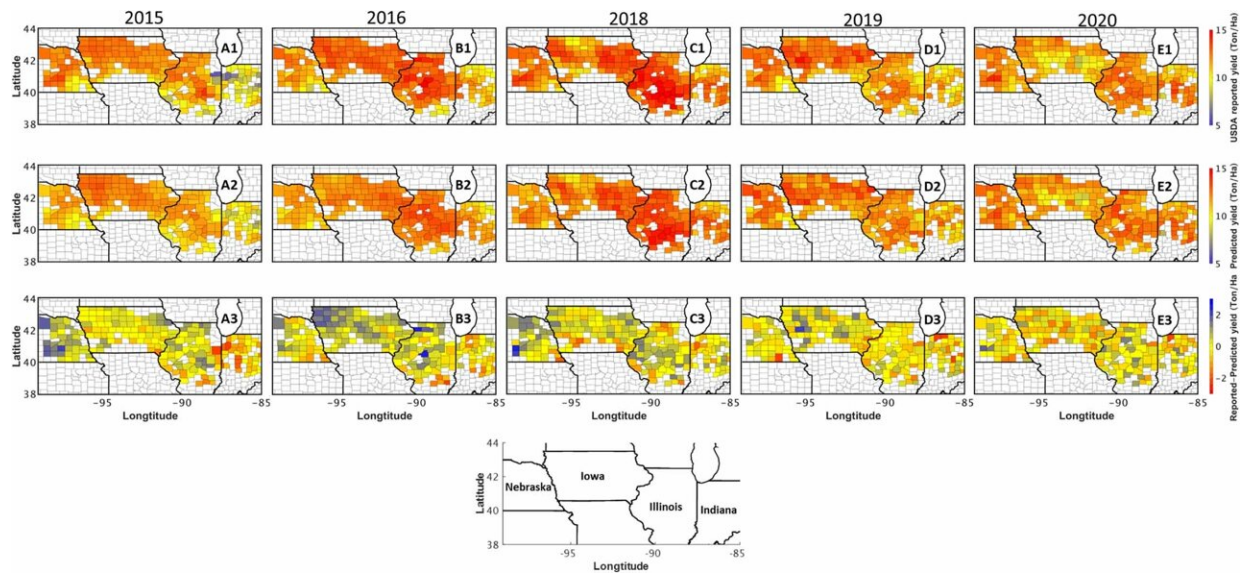


Satellite images of plants' fluorescence can predict crop yields

May 1 2024, by Laura Reiley



Corn yield maps from USDA reports (A1–E1), MLR-SIF estimates (calibrated) (A2–E2), and their difference (USDA—MLR-SIF) (A3–E3), for 2015, 2016, 2018, 2019, and 2020 respectively. Credit: *Environmental Research Letters* (2024). DOI: 10.1088/1748-9326/ad3142

Cornell researchers and collaborators have developed a new framework that allows scientists to predict crop yield without the need for enormous amounts of high-quality data—which is often scarce in developing countries, especially those facing heightened food insecurity and climate risk.

In many parts of the world, [crop yields](#) are dropping, largely due to the effects of climate change. According to a recent Cornell study, over the last four decades, for every 1 degree Celsius of warming, net farm income decreased by 66%.

Farmers in developed countries can often rely on big datasets and risk management tools to help reduce the impacts of extreme heat on their yield and income. But in developing countries, data is scarce, and it is often difficult to accurately measure crop yield.

In a paper [appearing](#) in *Environmental Research Letters*, the scientists suggest using satellite photos to remotely measure solar-induced [chlorophyll fluorescence](#) (SIF) as a way of assessing and predicting crop yield. Using sample fields of corn in the U.S. and wheat in India, the scientists have hit upon an approach that should, in principle, work universally for any crop, according to Ying Sun, a co-author and associate professor of soil and crop sciences in the College of Agriculture and Life Sciences (CALS).

Chlorophyll fluorescence is the reddish light re-emitted by photosynthetic tissues and organisms, she said, a measurement that serves as a proxy of photosynthetic energy conversion in plants.

"It won't tell you how many ears of corn are in a field," she said, "but step one is to model photosynthesis from fluorescence. Crop yield depends on photosynthesis. Here we have a mechanistic model, which is very important."

Co-author Chris Barrett, the Stephen B. and Janice G. Ashley Professor of Applied Economics and Management in the Charles H. Dyson School of Applied Economics and Management, and in the Cornell Jeb E. Brooks School of Public Policy, suggests this approach could be valuable for forecasting and targeting: for making [policy decisions](#), establishing

crop insurance and even forecasting areas of poverty.

This strategy takes advantage of the growing availability of satellite data and is cheaper to use and faster to access than other yield-prediction methods, he said.

"That's why I see this as promising. I can imagine this being helpful in predicting poverty at a village-level scale in rural areas where a lot of the economy is driven by agriculture," he said. "Those are places we have had a hard time collecting data and where things can change very quickly. If we're trying to take scarce resources and redirect them where they are going to have the biggest impact, this could be helpful."

This tool could be employed to help food assistance organizations and nongovernmental agencies be more fleet of foot in providing aid, Barrett said.

Sun said she and her colleagues are working on further research that would allow this kind of tool in the future to be used in real time to allow farmers to react, adjusting things like soil amendments or irrigation strategies to improve a current harvest's health and productivity.

In the U.S., the Department of Agriculture and other institutions provide enormous amounts of harvest data. Increasingly, machine learning models are being employed to make predictions, said lead author Oz Kira, of Ben-Gurion University of the Negev in Israel, and formerly a post-doc in Sun's lab, but these models presuppose similar environmental condition.

Kira suggests using chlorophyll fluorescence satellite data will allow for changing conditions.

"If growing conditions change, it's possible that predictions aren't

applicable," Kira said. "In our case, we are not basing our models on prior observation. This can take climate change into account."

The study's co-authors include Jiaming Wen, Ph.D.; Jimei Han, a postdoctoral researcher in Sun's lab; Andrew McDonald, associate professor in the School of Integrative Plant Science and the Department of Global Development (CALs); Ariel Ortiz-Bobea, associate professor of applied economics and policy (Dyson and Brooks School); and Yanyan Liu, adjunct professor (Dyson).

More information: Oz Kira et al, A scalable crop yield estimation framework based on remote sensing of solar-induced chlorophyll fluorescence (SIF), *Environmental Research Letters* (2024). [DOI: 10.1088/1748-9326/ad3142](https://doi.org/10.1088/1748-9326/ad3142)

Provided by Cornell University

Citation: Satellite images of plants' fluorescence can predict crop yields (2024, May 1) retrieved 16 May 2024 from <https://phys.org/news/2024-05-satellite-images-fluorescence-crop-yields.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.