

New method predicts how climate change will impact food production and financial institutions

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Researchers at the University of California San Diego School of Global Policy and Strategy have developed a new method to predict the

financial impacts climate change will have on agriculture, which can help support food security and financial stability for countries increasingly prone to climate catastrophes.

The study, published in the *Proceedings of the National Academy of Sciences*, uses climate and agricultural data from Brazil. It finds that climate change has a cascading effect on farming, leading to increased loan defaults for one of the nation's largest public sector banks. Over the next three decades, climate-driven loan defaults could increase by up to 7%, according to the study.

The projections in the paper revealed that although temperatures are rising everywhere, there is substantial variation in what that looks like from region to region, which underscores the need to build distinct types of physical and financial resilience.

For example, parts of northern Brazil are predicted to have more dramatic seasonal swings around 2050, with heavier rainfall in winter and drier summers, so policymakers should be thinking about the need for [water storage](#) by building dams and reservoirs as well as increasing groundwater storage capacity. Conversely, central Brazil may have fairly steady weather, but will have higher overall temperatures, pointing to a need for heat-resistant crops.

The authors of the paper used a statistical approach pairing past climate data in Brazil with information on crop productivity, farm revenue and agricultural loan performance. They combined this data with climate simulations to predict future weather conditions and their impacts on farming and how those changes will affect [financial institutions](#).

"A difficulty in studying climate impacts on agriculture is that there are all sorts of adaptations happening all the time that aren't easily observed, but are really important for understanding vulnerability and how risk is

changing," said co-author Jennifer Burney, professor of environmental science at UC San Diego's School of Global Policy and Strategy and Scripps Institution of Oceanography.

"We were able to distinguish signals from different types of climate impacts and which ones led to this larger [financial risk](#)."

Systematic thinking about building resilience against climate change around the globe

A key objective of the research is to support resilient [food security](#) under a changing climate, which requires understanding of when small climate shifts might have outsized impacts, spilling across regions or into other sectors through institutions like trade and banking.

Understanding the [systemic risk](#) posed by climate change is especially helpful for policymakers and disaster relief agencies, as climate change has increasingly become a national security threat. To that end, the statistical approach developed in the study could be applied around the globe.

"The technique we developed will help populations identify where they are most vulnerable, how [climate change](#) will hurt them the most economically and what institutions they should focus on to build resilience," said study co-author Craig McIntosh, professor of economics at the School of Global Policy and Strategy.

For example, some governments in the Western Pacific region buy extra food on the [global market](#) in emerging El Niño years, when their own crop productivity suffers. The [statistical approach](#) used in the study could help governments around the world understand their own climate conditions and whether local, regional or international institutions will be

best placed to address them.

The research could be especially helpful with the development of the loss and damage fund established by the United Nations in 2022. The fund is designed to help compensate developing nations that have contributed the least to the climate crisis but have been facing the brunt of its devastating floods, drought and [sea-level rise](#).

"Our technique could help countries think about where the resilience returns would be highest for the money spent," said Krislert Samphantharak, professor of economics at the School of Global Policy and Strategy. "This technique also helps to identify where international reinsurance might be needed."

The "Empirical Modeling of Agricultural Climate Risk" study was also coauthored by Bruno Lopez-Videla, who earned a Ph.D. in economics from UC San Diego in 2021 and Alexandre Gori Maia of the Universidade Estadual de Campinas in Brazil.

More information: Burney, Jennifer et al, Empirical modeling of agricultural climate risk, *Proceedings of the National Academy of Sciences* (2024). [DOI: 10.1073/pnas.2215677121](https://doi.org/10.1073/pnas.2215677121).
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