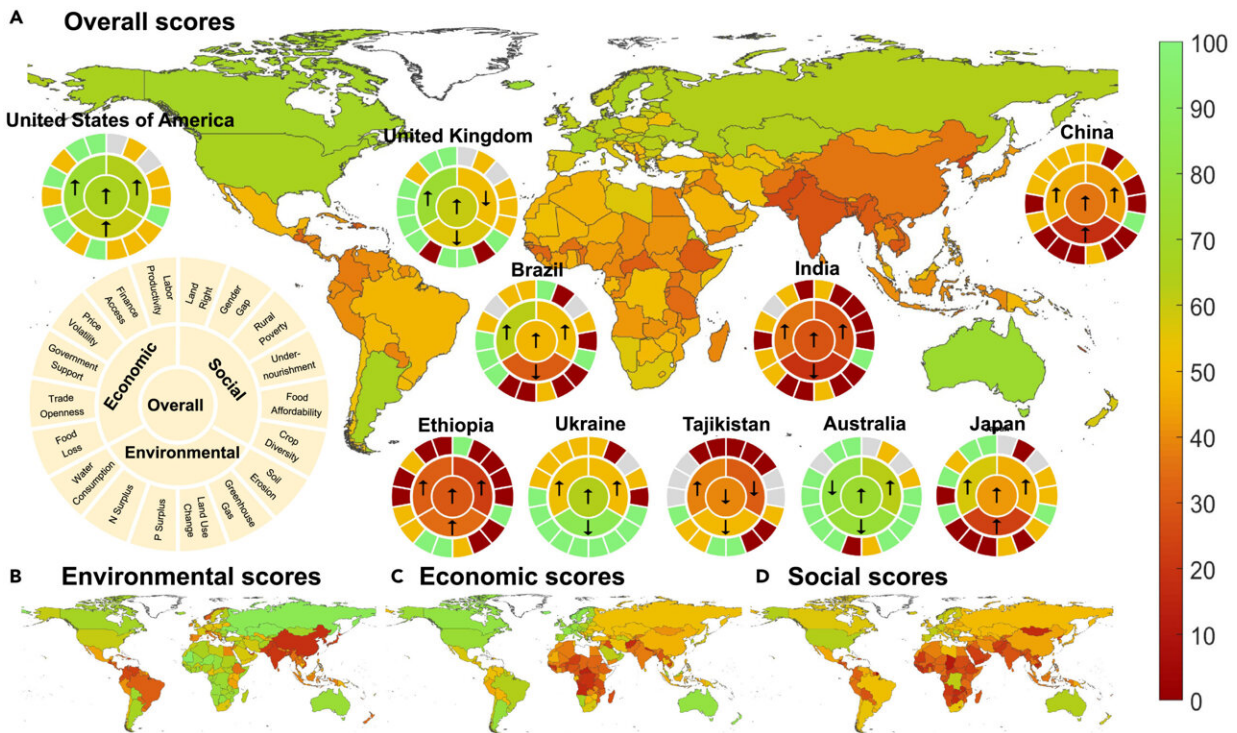


First-of-its-kind quantitative assessment for sustainable agriculture

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The Sustainable Agriculture Matrix measures environmental, economic, and social impacts of agriculture sustainably at a national level to help inform national policies and actions towards sustainable agriculture around the globe. Credit: University of Maryland Center for Environmental Science

For the first time, scientists have assembled a quantitative assessment for agriculture sustainability for countries around the world based not only

on environmental impacts, but economic and social impacts, as well. The Sustainable Agriculture Matrix, or SAM, provides independent and transparent measurements of agricultural sustainability at a national level that can help governments and organizations to evaluate progress, encourage accountability, identify priorities for improvement, and inform national policies and actions towards sustainable agriculture around the globe.

"This Sustainable Agriculture Matrix is an effort to promote accountability for nations' commitments towards [sustainable agriculture](#)," said project leader Xin Zhang of the University of Maryland Center for Environmental Science. "We hope this can serve as a tool to bring the stakeholders together. Agriculture production is not only about farmers. It's about everyone."

Agriculture is fundamental to [sustainability](#). However, the definition of "sustainable agriculture" and the ability to measure it have been difficult to quantify. The project to create the Sustainable Agriculture Matrix began in 2017 by bringing together about 30 stakeholders and experts from around the world—including Oxfam, the International Institute for Applied Systems Analysis, the International Food Policy Research Institute, and the United Nations Food and Agriculture Organization, as well as academic partners such as University College London, University of Queensland, University of California Berkeley and the University of Maryland Center for Environmental Science—to assess the impacts of agricultural production on a national scale around a diverse range of environmental, economic, and social dimensions of sustainability.

"Sustainable agriculture is a very complex concept and it means different things for different people, making it hard to assess," said Zhang. "To make the commitment to sustainable agriculture accountable, independent and transparent measurements of countries' sustainability are essential."

"The assessment of sustainability is not easy, especially given the dearth of social data across all countries. We hope with this matrix we can demonstrate the value of greater investment in social data to assess how agriculture affects and contributes to social equity as a critical dimension of agricultural sustainability," said co-author Kimberly Pfeifer from Oxfam America.

Globally, agriculture faces the challenge of increasing productivity to meet growing population demands for food, materials, and energy. Nations are tasked with developing a sustainable agriculture sector that is not only productive, but also nutritionally adequate, compatible with ecosystem health and biodiversity, and resilient. As a result, sustainable agriculture has been included as part of the Sustainable Development Goals ratified by all member countries of the United Nations in 2015.

The first edition of the matrix is composed of 18 indicators that measure the direct impacts of agricultural production on the environment and economy, and broader impacts on the whole society, recognizing that agriculture is deeply interconnected with other sectors. An emphasis in this first edition is on identifying trade-offs between performance indicators, such as between improved [economic performance](#) and reduced environmental performance, and also some less common examples of trade-offs such as increased agricultural subsidies did not necessarily improve human nutrition.

"There haven't been efforts that provide a comprehensive look at all three dimensions of agricultural impacts for countries around the world," said co-author Eric Davidson from the University of Maryland Center for Environmental Science. "The underlying concept of this matrix is a recognition that the agricultural system may have multiple impacts on sustainability."

For instance, while agricultural production may provide vibrant

economic benefits to the farming community and national economic development, it might also add stress on the environment in terms of water use, nutrient pollution, and biodiversity loss. How and if the national agricultural sector provides a healthy and sufficient diet for its own population may influence social equality.

"The comprehensive assessment for the sustainability of a country's agriculture provides a great opportunity to reveal the full range of potential tradeoffs, as well as synergies, among multiple sustainability goals, and allows informed choices in view of local or policy priorities," said co-author Amy Heyman of the United Nations Food and Agriculture Organization.

"While most countries have demonstrated strong tradeoffs between environmental and economic dimensions of agricultural sustainability, there are countries, such as the United States, showing some promising signs of achieving synergies between enhancing agricultural productivity and reducing environmental impacts," said co-author Guolin Yao from the University of Maryland Center for Environmental Science.

"I want to broaden the view of agricultural management. It's not only about what's going on farm but what's going on in the market, during policy debates, and on our plates. Day-to-day consumer choices have a fundamental impact on what's being produced, as well as where and how it's being produced," Zhang said.

"The green revolution made it possible for humanity to feed huge population growth in past decades, but this came at the price of large impacts to the environment and a neglect of human nutrition and overall well-being," said co-author Kyle Davis of the University of Delaware. "Our SAM approach provides a promising step beyond the shortcomings of the green revolution while trying to build on the past successes of global agriculture."

As a next step, the SAM consortium, a project funded by the Belmont Forum, is launching with six pilot countries and regions, including USA, Austria, Brazil, Turkey, South Africa, Sub-Saharan Africa. The consortium will use the first edition of SAM indicators as a starting point to engage conversations and coordination among stakeholders, and to co-develop country cases to identify strategies towards sustainable agriculture.

"Having the assessment is an important first step toward agricultural sustainability, especially in marginal production areas in Africa," said SAM consortium partner Tafadzwa Mabhaudhi from the University of KwaZulu-Natal, South Africa.

"This is a useful starting point for not only evaluating progress, but also identifying priorities for improvement, and informing national policies and actions towards sustainable [agriculture](#)," said co-author and SAM consortium partner Christian Folberth from the International Institute for Applied Systems Analysis.

More information: Xin Zhang et al, Quantitative assessment of agricultural sustainability reveals divergent priorities among nations, *One Earth* (2021). [DOI: 10.1016/j.oneear.2021.08.015](https://doi.org/10.1016/j.oneear.2021.08.015)

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