

Agricultural revolution in Africa could increase global carbon emissions

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Purdue agricultural economist Thomas Hertel and fellow researchers say that an agricultural revolution in Africa could have strikingly different global impacts from the Green Revolutions of the past. Credit: Purdue University / Tom Campbell

Productivity-boosting agricultural innovations in Africa could lead to an increase in global deforestation rates and carbon emissions, a Purdue University study finds.

Historically, improvements in agricultural technology have conserved land and decreased [carbon emissions](#) at the global level: Gaining better yields in one area lessens the need to clear other areas for crops, sidestepping a land conversion process that can significantly raise the amount of carbon dioxide released into the atmosphere.

Agricultural advances in Africa, however, could have the reverse effect, increasing globally the amount of undeveloped land converted to cropland and raising greenhouse gas emissions, said Thomas Hertel, a distinguished professor of agricultural economics.

"Increasing productivity in Africa - a carbon-rich region with low agricultural yields - could have negative effects on the environment, especially if agricultural markets are highly integrated," he said. "This study highlights the importance of understanding the interplay between globalization and the environmental impacts of agricultural technology. They are deeply intertwined."

Debate surrounds the effects of agricultural innovation on the environment, Hertel noted. Some researchers suggest that increasing the profitability of farming will amplify its negative environmental effects, raising [greenhouse gas emissions](#) and accelerating tropical deforestation. Others argue that intensifying agricultural production is better for the environment overall because more land can be spared for nature if the same amount of crops can be produced using less land.

"We set out to determine who was right," Hertel said. "We discovered that both hypotheses can be valid - it depends on the local circumstances."

Hertel and fellow researchers Navin Ramankutty and Uris Baldos developed a novel economic framework to analyze the effects of regional improvements in agricultural technology on global rates of land

use and carbon emissions. Their analysis showed that historical "green revolutions" in regions such as Latin America and Asia - in which better varieties of cereal grains produced dramatic gains in harvests - helped spare land and diminish carbon emissions compared with an alternative scenario without crop innovations.

The global effects of a [green revolution](#) in Africa, however, are less certain, Hertel said.

"If the future global economy remains as fragmented as it has been historically - a world of very distinct agricultural markets - then a green revolution in Africa will lower [global carbon emissions](#)," he said. "But if markets become more integrated, faster agricultural innovation in Africa could raise global carbon emissions in the coming decades."

In an integrated world markets scenario, the researchers' analysis showed that ramping up agricultural productivity in Africa over the years 2025-2050 could increase global cropland expansion by 1.8 million hectares (4.4 million acres) and global carbon emissions by 267 million metric tons.

The sharp differences between the global impacts of a prospective African green revolution and those of previous green revolutions can be traced to several factors, Hertel said.

In an African green revolution, the relatively lower yields of African croplands would require more area to be converted to agriculture to make up for the displaced crop production in the rest of the world. The area converted would likely be carbon intensive and have a low emissions efficiency – that is, crop yields would be low relative to the carbon emissions released by converting the land to crops.

But the potential negative effects of an African green revolution will

diminish over time, Hertel said. If sustained over several decades, agricultural innovation in Africa would eventually conserve land and decrease carbon emissions, especially if yields improved quickly. The most carbon-rich land, however, should be immediately protected from conversion to cropland, he said.

"We need to prevent regions in Africa that are rich in carbon and biodiversity from being cleared for agriculture to avoid increasing emissions," he said. "Boosting yields brings many benefits, but increasing global food supplies while minimizing the environmental footprint of agriculture remains a major challenge."

Provided by Purdue University

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