

Governments, researchers underestimate impact of inefficient land-use on climate change

December 12 2018



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Policymakers and researchers have underestimated the effect that changes in land management and people's diets would have on limiting greenhouse gas emissions and countering the effects of climate change, according to a study led by Princeton University.

The researchers report in the journal *Nature* Dec. 13 that the inefficient use of land for agriculture and even alternative-fuel production greatly increases [greenhouse gas emissions](#). They provide a "carbon benefits index" for calculating whether efforts to combat climate change are helped or hurt by switching [agricultural production](#) from corn to soybeans to tropical fruits, or from cropland to grazing land or bioenergy, or back to forest.

"We have to take the implications of policies for land use even more seriously than people have been doing," said first author Tim Searchinger, a research scholar in Princeton's Woodrow Wilson School of Public and International Affairs and a lecturer in the Princeton Environmental Institute (PEI). Searchinger worked with co-authors Stefan Wirsenius of Chalmers University in Sweden, Tim Beringer of the Humboldt Institute at Berlin, and Patrice Dumas of the French Agricultural Research Centre for International Development (CIRAD).

"The [fundamental problem](#) is that policymakers and researchers have not truly confronted the fact that global land area is limited," Searchinger said. "Using any hectare (2.47 acres) for one purpose comes at the cost of not using it for another, and these opportunity costs have not been truly accounted for. The need is to make more efficient uses of land for all purposes."

Because the need for food and carbon storage are projected to greatly increase in the next 50 years, the researchers wanted to examine the changes in land use or consumption that would contribute to mitigating climate change by achieving both ends efficiently.

Factoring in land costs fully, the researchers found that diets in wealthy nations have far higher greenhouse gas consequences than typically calculated. They reported that the average European diet produces as much greenhouse gases per year—9 gigatons, or 9 billion metric tons

— as is normally calculated for their consumption of everything else combined, including energy. The researchers found that shifting from a diet based on meat such as beef, lamb and dairy to other foods would reduce these emissions by 70 percent.

At the same time, the climate could benefit from changes in how food is produced. The researchers found that more careful management of grazing on one hectare of land in Brazil just from poor to medium-level quality would increase the world's capacity to store carbon to the same extent as planting one hectare of forest in Europe or the United States.

Even land-intensive steps to reduce carbon dioxide emissions such as growing crops for alternative fuels can be ultimately counterproductive, the researchers reported. Consuming ethanol or biodiesel contributes two to three times the greenhouse gas emissions of gasoline or diesel over a 30-plus-year period. On the other hand, vehicles that run on solar-sourced electricity—even using the inefficient batteries currently available—produce 12 percent of the greenhouse gases that result from the average use of gasoline and diesel.

Calculating the efficient use of land can be difficult because different uses lead to different outputs, Searchinger said. "When land shifts from producing corn to growing soybeans or kumquats, or is converted to forest or pasture or growing crops for bioenergy, does that increase or decrease land use efficiency? How much corn is worth how much kumquats and how much forest," he asked.

The index the researchers developed answers these questions by estimating the level of greenhouse gases the world emits on average to produce each type of food. They include the carbon that would have been stored in forests and savannas converted to agricultural land; that unabsorbed carbon accounts for 20-25 percent of the greenhouse gases in the atmosphere, the researchers reported.

Just as the economic value of different products such as a coat and a taxi ride can be compared based on the costs of producing them, the study reasons that the "climate value" of a kilogram of corn or vegetables can be based on the carbon lost to make them. Policymakers, farmers or private companies can use that value to determine whether shifting from producing one food to another—or transitioning to bioenergy or forest restoration—generates more "carbon benefits" and therefore helps or harms efforts to solve climate change.

"It is important to increase both the efficiency of production on land and the efficiency of what we consume, but it's equally important that policymakers separate their efforts to influence each," Searchinger said.

"For example, beef is very climate-inefficient and people can help the planet by eating less of it, but so long as people demand beef, farmers can help the planet by grazing beef more efficiently," he said. "Just discouraging a farmer from producing beef would hurt the climate because some less efficient farmer would likely produce the beef anyway."

The paper is titled "Assessing efficiency of changes in [land use](#) for mitigating [climate change](#)," was published by *Nature* Dec. 13.

More information: Assessing the efficiency of changes in land use for mitigating climate change, *Nature* (2018). [DOI: 10.1038/s41586-018-0757-z](#) , www.nature.com/articles/s41586-018-0757-z

Provided by Princeton University

Citation: Governments, researchers underestimate impact of inefficient land-use on climate

change (2018, December 12) retrieved 23 April 2024 from
<https://phys.org/news/2018-12-underestimate-impact-inefficient-land-use-climate.html>

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