

# Study shows hope of greater global food output, less environmental impact of agriculture

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Can we have enough to eat and a healthy environment, too? Yes—if we're smart about it, suggests a study published in *Nature* this week by a team of researchers from the University of Minnesota and McGill University in Montreal.

[Global demand](#) for food is expected to double by 2050 due to [population growth](#) and increased standards of living. To meet this demand, it is often assumed we will need to expand the environmental burden of agriculture. The paper, based on analysis of agricultural data gathered from around the world, offers hope that with more strategic use of fertilizer and water, we could not only dramatically boost global crop yield, but also reduce the adverse environmental impact of agriculture.

"We have often seen these two goals as a trade-off: We could either have more food, or a cleaner environment, not both," says lead author Nathaniel Mueller, a researcher with the University of Minnesota's Institute on the Environment and a doctoral student in the College of Food, Agricultural and Natural Resource Sciences. "This study shows that doesn't have to be the case."

Mueller and colleagues used management and yield data for 17 major crops to take a big-picture look at how much water and nutrients it would take to bring underperforming farmlands to meet their food production potential. They also looked for places where fertilizer use

could be cut down without substantially reducing crop yield. They found:

- We could boost production 45 to 70 percent for most crops. The greatest opportunities for yield improvement are found in Eastern Europe, sub-Saharan Africa, East Asia, and [South Asia](#).
- Different inputs serve as limiting factors depending on the region and crop. Nutrients, for example, appear to be limiting [corn production](#) in Eastern Europe and West Africa and [wheat production](#) in Eastern Europe, while nutrients and water appear to limit [rice production](#) in [Southeast Asia](#).
- Worldwide, we could decrease nitrogen use 28 percent and phosphorus use 38 percent without adversely affecting yields for corn, wheat and rice. China stands out as a hot spot of nutrient overuse, but other areas, like the United States, Western Europe, and India, also have room to improve.
- With strategic redistribution of nutrient inputs, we could bring underperforming lands worldwide to 75 percent of their production potential while only increasing global nitrogen use 9 percent and potassium use 34 percent—and reducing phosphorus use 2 percent.

The researchers caution that their analysis is at a coarse scale and that many other factors, including land characteristics, use of organic fertilizers, economics, geopolitics, water availability and climate change will influence actual gains in crop production and reductions in adverse environmental impacts. Nevertheless, they are encouraged by the strong indication that closing the "yield gap" on underperforming lands—previously identified as one of five promising points for meeting future food needs, along with halting farmland expansion in the tropics, using agricultural inputs more strategically, shifting diets and reducing food waste—holds great promise for sustainably boosting [food](#) security.

"These results show that substantial gains are indeed possible from closing the yield gap—and combining these efforts with improved management of existing lands can potentially reduce agriculture's environmental impact," Mueller says. "They also offer concrete suggestions as to where and how we can focus future efforts. This work should serve as a source of great encouragement and motivation for those working to feed the 9-billion-plus people anticipated to live on this planet in 2050 while protecting Earth's indispensable life support systems."

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