

# Widely accepted vision for agriculture may be inaccurate, misleading

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Agricultural research, like that conducted at Penn State's Russell E. Larson Agricultural Research Center (shown) is facing daunting challenges as scientists attempt to greatly increase food production in a sustainable way and protect the environment. Credit: Randy Kilmer

"Food production must double by 2050 to feed the world's growing

population." This truism has been repeated so often in recent years that it has become widely accepted among academics, policymakers and farmers, but now researchers are challenging this assertion and suggesting a new vision for the future of agriculture.

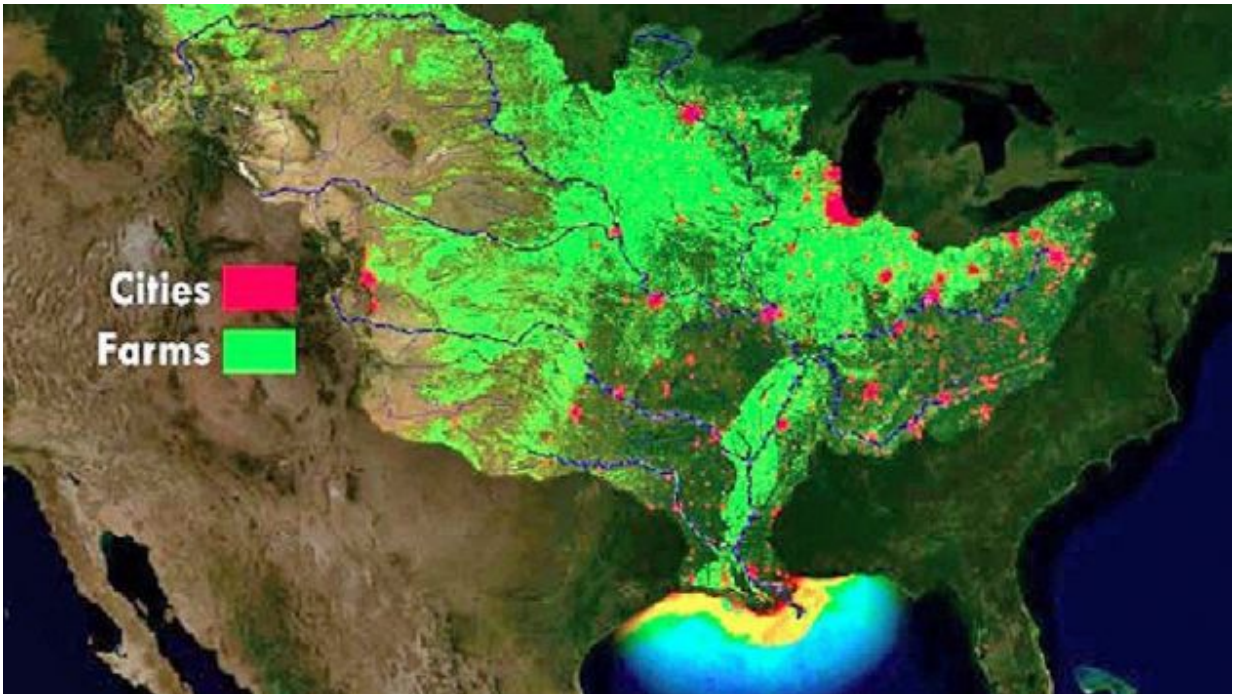
Research published today (Feb. 17) in *Bioscience* suggests that production likely will need to increase between 25 percent and 70 percent to meet 2050 food demand. The assertion that we need to double global crop and animal production by 2050 is not supported by the data, argues Mitch Hunter, doctoral student in agronomy, in Penn State's College of Agricultural Sciences. He says the analysis shows that production needs to keep increasing, but not as fast as many have claimed.

However, clarifying future food demand is only part of the story.

"In the coming decades, [agriculture](#) will be called upon to both feed people and ensure a healthy environment," said Hunter. "Right now, the narrative in agriculture is really out of balance, with compelling goals for food production but no clear sense of the progress we need to make on the environment. To get the agriculture we want in 2050, we need quantitative targets for both food production and environmental impacts."

A review of recent trends in agriculture's environmental impacts shows that they are increasing and must drop dramatically to maintain clean water and stabilize the climate, according to the researchers. Hunter sees the research as a

Specifying quantitative targets, the researchers contend, will clarify the scope of the challenges that agriculture must face in the coming decades, focusing research and policy on achieving specific outcomes.



Last year, the dead zone in the Gulf of Mexico, one of the globe's most productive fisheries, was about the size of Connecticut. It results, primarily from the runoff of excess nutrients such as phosphorus and nitrogen from agriculture. Credit: NOAA

"Food production and environmental protection must be treated as equal parts of agriculture's grand challenge," says study co-author David Mortensen, professor of weed and applied plant ecology, Penn State.

These new findings have important implications for farmers. Lower demand projections may suggest that prices will not rise as much as expected in coming decades. However, the authors note that economic forecasting models already are based on up-to-date quantitative projections, so price forecasts may not be affected greatly by this new analysis.

At the same time, farmers will need to ramp up efforts to hold nutrients on their fields, reduce [greenhouse gas emissions](#) and improve soil health.

This analysis builds on the two most commonly cited food-demand projections, one from the United Nations Food and Agriculture Organization and one led by David Tilman, a prominent ecologist at the University of Minnesota. Hunter and his colleagues did not dispute these underlying projections; they simply updated them to help reframe the narrative.

"Both of these projections are credible and important, but the baseline years they used are over a decade past now, and global production has ramped up considerably in that time," Hunter explained.

So, while Tilman's study showed that the world will demand 100 percent more calories in 2050 than in 2005, that is the equivalent of only a 68 percent increase over production levels in 2014, the most recent year with available data. To meet the FAO projection, which used different assumptions and projected lower demand, production would have to increase only 26 percent from 2014 levels.





Agricultural scientists, like Penn State researchers, have been experimenting with cover crop mixtures (like the one shown growing at the Russell E. Larson Agricultural Research Center) to determine which ones best limit the runoff of nutrients and provide the most ecosystem services. Credit: Mitch Hunter

"Given how much production has increased recently, it is pretty

misleading to continue to argue that we need to double our crop output by 2050," Hunter said.

Aiming to double food production makes it much harder to move the needle on our environmental challenges.

"To double food production, we would have to increase global agricultural output faster than we ever have before, and we are at a point in the developed world where we already are pushing our farming systems to the max. We don't know how to double yields in these systems, especially without multiplying our environmental impacts," Hunter said.

Despite increased discussion of sustainability in agriculture, the common narrative that we need to drastically increase food production is seldom challenged in agricultural circles, according to the researchers. This is partly because definitions of sustainability vary widely, ranging from "not increasing agriculture's environmental footprint" to achieving "major reductions in environmental impact."

The researchers present hard data and quantitative goals to help clear up this confusion. For global greenhouse gas emissions and nutrient pollution in the Mississippi River Basin, the data show that agriculture's environmental performance is going in the wrong direction, with aggregate impacts steadily increasing. Science-based goals indicate that these impacts must fall sharply over the coming decades to avoid the worst impacts of climate change and reduce the size of the "dead zone" in the Gulf of Mexico.

The authors argue for research and policy efforts to help identify production methods that can meet growing global food demand while also hitting sustainability targets.

"Even with lower demand projections, growing enough food while protecting the environment will be a daunting challenge," Hunter said.

"We call on researchers, policymakers and farmers to embrace this recalibrated vision of the future of agriculture and start working toward these goals."

Provided by Pennsylvania State University

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