New study measures how nitrogen is managed in agriculture around the world

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The business world is familiar with Peter Drucker's assertion that "If you can't measure it, you can't improve it." For the sake of environmental sustainability and food security, there is an urgent need for agriculture to

improve its use of nitrogen fertilizers, but can we properly measure it?

A new paper published in *Nature Food* offers the first comprehensive comparison of the most advanced international efforts to measure how nitrogen is managed in agriculture. Zhang et al synthesize results from nearly thirty researchers from ten different research groups across the world, including universities, private sector fertilizer associations, and the United Nations Food and Agriculture Organization (FAO). They each estimated how much nitrogen is added to croplands as fertilizer and manure, how much of the added nitrogen is harvested in crops, and how much is left over as potential environmental pollution.

"This intercomparison project enables researchers, agronomists, and policy makers to identify where we can improve nitrogen budget estimates," said lead author, Associate Professor Xin Zhang of the University of Maryland Center for Environmental Science. "This knowledge is the basis for improving sustainable nitrogen management and for addressing food security and environmental pollution challenges."

Nitrogen matters because it is essential for farmers to obtain good crop yields, but when a large fraction of it is not taken up by the intended crops, it leaks into the environment as nitrate in groundwater, rivers, lakes, and estuaries, where it contributes to noxious and harmful algal blooms and can pose human health risks. Excess nitrogen can also be lost from croplands as gaseous pollutants that pose respiratory human health risks and contribute to climate change and stratospheric ozone destruction. Hence, nitrogen needs to be managed carefully to maximize food production but minimize environmental pollution.

"Learning how to monitor nitrogen use in agriculture is a fundamental component of the 2030 Sustainable Development Agenda," said coauthor Dr. Francesco Tubiello of the FAO in Italy. "This study

supports the development of improved national statistics that can be used to this end."

"At first blush, this new study demonstrated some surprising and troubling differences among the ten research groups, suggesting that our ability to measure, and thus manage this essential nutrient and potent pollutant is not as good as it needs to be," said Eric Davidson, Professor at the University of Maryland Center for Environmental Science. "Digging into the data more deeply, however, many of these differences were explained by varying definitions and methods used by the different groups."

There is widespread agreement among these experts that use of nitrogen fertilizers in still growing, the average global efficiency of their use is stagnant, and so the surplus nitrogen that is not taken up by crops is also growing at a troubling rate. The types of crops and the geographic regions where improvements in measurement were also identified, thus facilitating needed improvements in both measurements and management.

"The United Nations Environment Programme adopted a resolution in 2019 calling for a global action to promote sustainable nitrogen management," noted contributing author Dr. Luis Lassaletta of Universidad Politécnica de Madrid. "Cutting nitrogen waste in half by 2030 would be an ambitious goal that would significantly improve environmental quality," he added.

The first step to action, however, is to obtain good estimates of nitrogen budgets in agricultural systems, as demonstrated in this study, so that we can better manage what we are able to measure with greater confidence.

"Quantification of global and national nitrogen budgets for crop production" was published in *Nature Food* on July 15.

More information: Quantification of global and national nitrogen budgets for crop production, *Nature Food* (2021). DOI: 10.1038/s43016-021-00318-5 , www.nature.com/articles/s43016-021-00318-5

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