Better nitrogen management yields more than it costs

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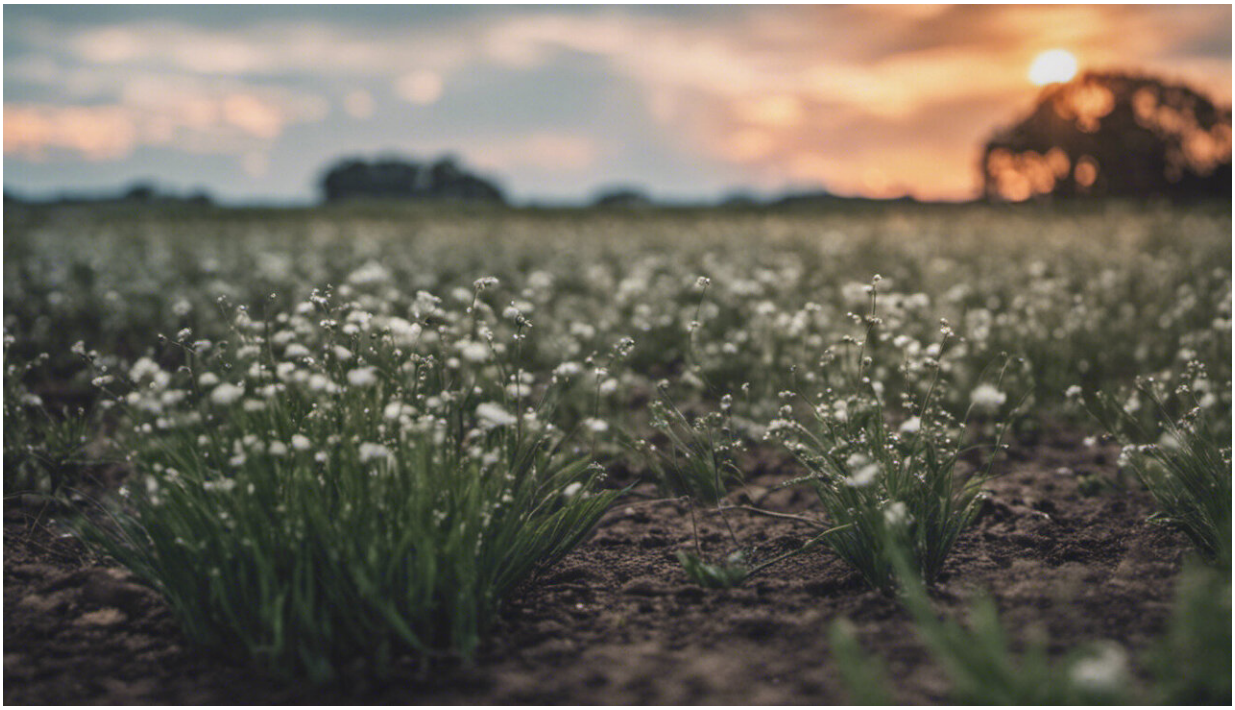

Credit: AI-generated image (disclaimer)

Better management on agricultural lands to reduce nitrogen losses to the environment costs only a fraction of what it provides. This could yield nearly $500 billion in societal benefits globally for both food supply and human health, ecosystems and the climate. And this at a net cost of nearly $20 billion. That's according to a study published today in the

scientific journal *Nature*.

To increase the supply of food and feed, agriculture was intensified using more and more nitrogen fertilizers and manure. However, more than half of these nitrogen inputs to croplands are lost to the environment, contributing to air pollution–related human diseases, eutrophication of waters, soil acidification, climate change and biodiversity loss. Nitrogen pollution has become a global challenge and part of the solution of the climate and biodiversity crisis.

The nature of nonpoint source pollution from millions of farms throughout the world, as well as the complexity and diversity of adopting farm-scale abatement techniques for farmers, make it extremely difficult to effectively reduce nitrogen pollution from croplands on a global scale. Bridging knowledge gaps to facilitate a multi-sectoral dialogue around mitigating nitrogen emissions is necessary. An international team of researchers from China, Australia, Austria, Germany, U.K. and the Netherlands explored cost-effective nitrogen mitigation strategies for global croplands in this new study.

Tiered mitigation options

Based on a meta-analysis of 1,521 field observations over the past 20 years, the researchers identified a package of feasible mitigation measures, primarily consisting of efficiency-enhancing fertilizers (EEFs), improved nutrient management by applying the right type of fertilizers at the right application rate, time and place, irrigation and legume rotations. These measures can strongly mitigate nitrogen losses from farmland across the globe, while also improving yields. However, the potential improvement and the barriers to implementation and costs of different abatement measures vary widely.

Multiple social benefits

In this new study, the scientists show that if smart abatement measures were implemented on global croplands, 22 million tons (-21%) of nitrogen fertilizer could be saved, and 26 million tons of nitrogen loss could be avoided, while an additional 17 million tons (+20%) of crop nitrogen could be harvested annually. These global changes could generate $476 billion in societal benefits for food supply, human health, ecosystems and climate, at a net abatement cost of only $19 billion.

"However, these management and technologies are seldom fully implemented by farmers due to many constraints, such as a high heterogeneity of best practices on the local scale and high implementation costs for farmers" says Prof. Wim de Vries from WUR. "Full implementation of these knowledge-based nitrogen mitigation measures by farmers thus needs to overcome financial barriers, since additional economic inputs are required which may override their net economic earns."

Nitrogen credit system

The scientists therefore advocate that the cost should be paid by society as a whole since it will benefit from less nitrogen pollution. They propose an innovative agricultural nitrogen credit system that acknowledges the responsibilities and limitations of the multiple parties along the food chain, including farmers, suppliers, processors, retailers, consumers, and governments. The nitrogen credit system provides economic incentives (e.g., subsidies based on the implementation cost and societal benefit) to farmers to adopt certified environmentally friendly practices to mitigate nitrogen pollution.

More information: Baojing Gu, Cost-effective mitigation of nitrogen

pollution from global croplands, *Nature* (2023). DOI: 10.1038/s41586-022-05481-8.
www.nature.com/articles/s41586-022-05481-8

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