Assessing future nitrogen fertilizer demand and use for the shared socioeconomic pathways

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Abstract

Inefficiencies in global cropland nitrogen use have led to the dissemination of reactive nitrogen throughout the hydrosphere. Assessing the future N input requirements and N use in agriculture for the five shared socioeconomic pathways (SSPs) reveals a range of possible future synthetic fertilizer inputs from 85-260 Tg N yr^{-1}. Importantly, apart for the sustainability SSP1, where N use efficiencies exceed 60% globally, all other scenarios are projected to exceed acceptable limits of excess N in developing regions.

Keywords: Nitrogen use efficiency, Synthetic N demand, Shared socioeconomic pathways

1. Introduction

Agricultural demand drives the global nitrogen cycle. Future factors affecting agriculture include population and dietary change, technology advancement, trade and global cooperation, and economic growth. Pinpointing regions susceptible to future environmental issues related to agricultural N use under various future storylines can aid in focusing efforts for improving their N use efficiencies (NUEs).

2. Methods

This study uses a hyperbolic relationship to relate N inputs into croplands to their respective per hectare yields according to a theoretical asymptote (Ymax) following Lassaletta et al (2014). We related Ymax for each region to the GDP/capita, allowing assessment of future propagations of Ymax which, when coupled to future cropland yields from the Integrated Model to Assess the Global Environment (IMAGE), allows projection of future N requirement.

3. Results and discussion

Global N fertilization steadily increased during the 20th century, a trend projected to continue up to 2050 under most scenarios. Nevertheless, assuming that all global regions are able to reach target NUEs of >60%, the global synthetic fertilizer demand in croplands can drop from the 95 Tg N yr^{-1} in 2005 to 85 Tg N yr^{-1} in 2050, improving the global balance between cropland production and ecosystem preservation, sparing both N and land. This SSP1 scenario results in a marked decrease in the agricultural N demand per capita, whereas all other scenarios forecast an increase synthetic N fertilizer use (Mogollón et al 2018).

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