

Nitrogen and water pollution in China

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Food security and the nitrogen-flow pattern in China have been radically changed in the past 60 years. The traditional agricultural systems, which were mainly relied on recycling organic waste, are considered sustainable because the continuous productivity could be maintained without signs of environmental degradation for thousands of years. Synthetic nitrogen fertilizers, especially after the 1970s, have been increasingly applied in croplands to meet the food demands of the fast population growth, and contributed about $45 \pm 3\%$ of current grain yields. The traditional practices of recycling organic waste as fertilizer have been largely abandoned. The nutrient recycling rate has decreased from over 90% in the late 1970s to 36% in 2014. The overuse of fertilizers and the increased nitrogen discharge from organic waste have resulted in pervasive water pollution after the mid-1980s. Combining biogeochemical modeling with observational data, our research team identified the critical nitrogen-discharge thresholds of the representative river catchments, and found that the current annual nitrogen discharges (14.5 ± 3.1 million tons per year, MtN yr^{-1}) is far beyond the national threshold of $5.2 \pm 0.7 \text{ MtN yr}^{-1}$. Reducing the nitrogen discharges to the safe levels requires a holistic approach, which includes improving nitrogen use efficiency (NUE) in croplands, and increasing the current nutrient recycling rate to at least 86%.