Societal benefits of halving agricultural ammonia emissions in China far exceed the abatement cost

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Abstract

This study conducts the first comprehensive assessment of national NH_3 mitigation based on multiple models. Our study reveals there are considerable societal benefits (US$ 32-75 billion) for China to reduce agricultural NH_3 emissions compared to its implementation costs (US$ 6-11 billion). The technical mitigation potential of agricultural NH_3 emissions in China is 53% (38-67%), around two times higher than $Europe_{27}$ (~24%). Saving unnecessary N fertilizer use and protein-rich feed could provide 30% of mitigation potential without abatement cost. Apart from technical mitigation options, reducing the consumption of animal products could offer further NH_3 mitigation potential by 2050.

Keywords: best farming practices, cropland, livestock, abatement cost, health and ecosystem benefit, mitigation pathway

1 Background

Growing evidence suggests that further improvement of air quality and public health in China needs the involvement of NH_3 mitigation. However, China has not yet formulated and introduced policies to reduce NH_3 emissions and there is no available systematic assessment of NH_3 mitigation potential, costs and benefits.

2 Agricultural NH_3 mitigation potential and costs

2.1 Marginal abatement cost curve (MACC)

A bottom-up NH_3 MACC (Fig.1) for China reveals that a reduction of 1.6 Tg NH_3-N (30% of the total reduction) is potentially available at zero cost for the agricultural sector by saving unnecessary fertilizer use and protein-rich feed.

2.2 Comparison with other countries

China has around two times higher NH_3 mitigation potential (~53%) than the EU_{27} (~24%) and Canada(~29%) with lower unit implementation cost (US$ 0.8-2.1 per kg NH_3-N abated). This is not surprising because as a developing agriculture country, China has the highest level of NH_3 emissions in the world and has not yet implemented mitigation policies.

3 Mitigation passway and environmental benefits

Four mitigation scenarios (DIET, NUE, REC, and ALL) towards 2050 are simulated to explore optimal NH_3 mitigation pathways. Results reveal that ALL scenario has the largest NH_3 mitigation potential and abatement costs, but also the highest net economic benefits (US$ 44-77 billion).

4 Policy implications

Saving unnecessary N fertilizer use and protein-rich feed (cheap and easy mitigation options) should be introduced first to pick the “low-hanging fruit” of NH_3 mitigation in China. Apart from improving agricultural management with technical options, human dietary change, as a non-technical strategy, will play an important role in reducing agricultural NH_3 emissions in China in the next 30 years.

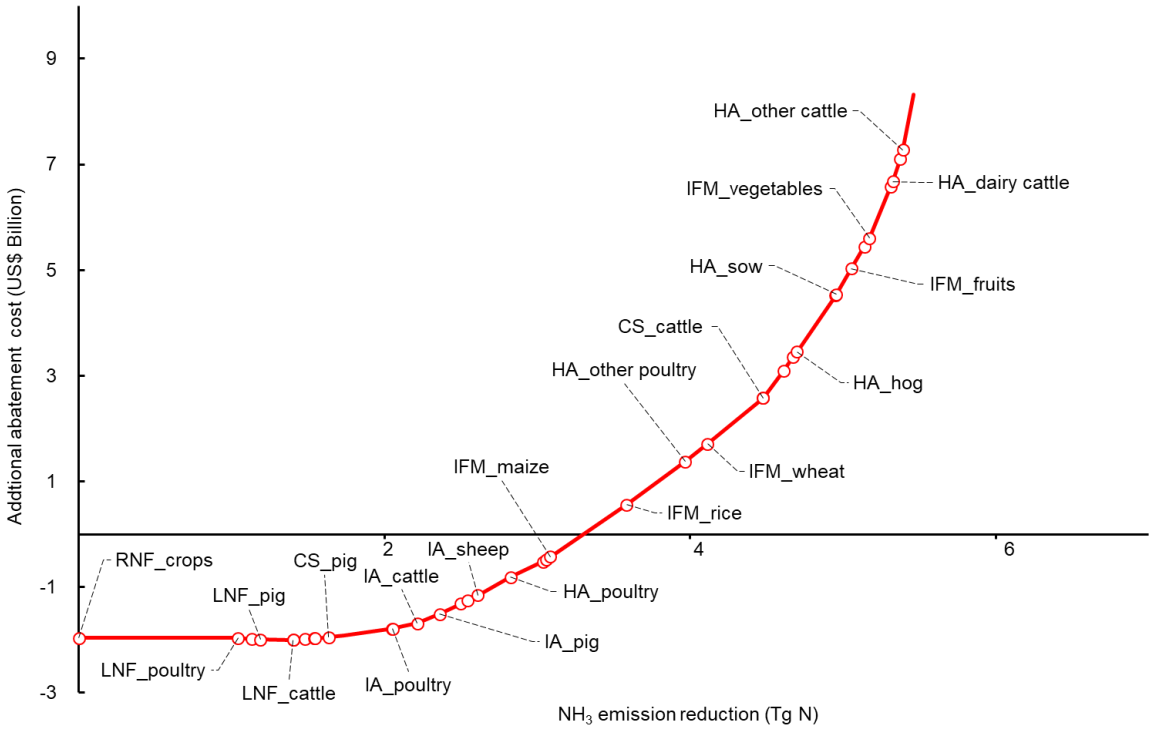

Fig.1 MACC of agricultural NH_3 emissions in China in 2020. The red dots represent the introduction of specific mitigation options. RNF, reduction of synthetic N fertilizer; LNF, low nitrogen feeding options; CS, covered storage measures; IA, improved application options; HA, housing adaption options; IFM, improved fertilization management.