



The reactive nitrogen loss and GHG emissions from a maize system after a long-term livestock manure incorporation in the North China Plain

Shufang Guo^{a,b}, Junting Pan^a, Limei Zhai^{a,*}, Benyamin Khoshnevisan^a, Shuxia Wu^a, Hongyuan Wang^a, Bo Yang^a, Hongbin Liu^a, Baokun Lei^b

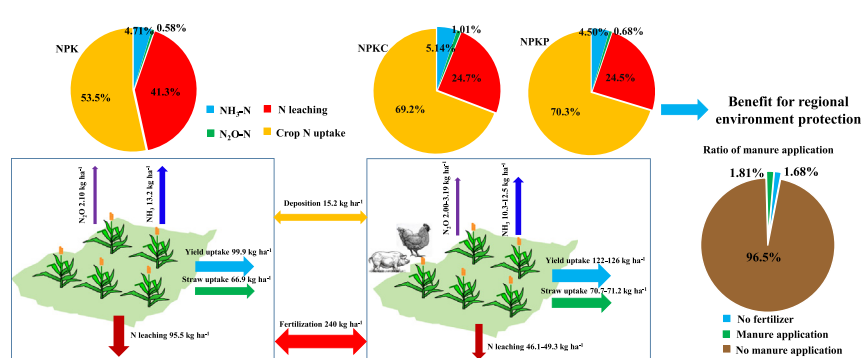
^a Key Laboratory of Nonpoint Source Pollution Control, Ministry of Agriculture and Rural Affairs/Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, China

^b Institute of Agricultural Environment and Resources, Yunnan Academy of Agricultural Sciences, Kunming 650201, China

HIGHLIGHTS

- Appropriate manure application ratio improved crop yield, SOC and TN.
- 50% N from manure applied for maize crop mitigated N losses by approximately 45%.
- Appropriate manure application for cereal crops could decrease N losses in the NCP.

GRAPHICAL ABSTRACT



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ABSTRACT

The use of livestock manure as a substitution for synthetic nitrogen (N) fertilizers is recommended to improve the sustainable use of manure nutrients and alleviate the adverse impacts of synthetic N fertilizers on the environment. A thorough understanding of how such substitutions affect reactive N losses and greenhouse gas (GHG) emissions in cereal production systems in the North China Plain (a main livestock production region in China), is needed to achieve an environmental friendly and sustainable production. Based on a long-term field experiment, different manure/chemical fertilizer treatments were designed, i.e., non-fertilization control (CK), chemical fertilizers alone (NPK), and manure substitution for chemical N fertilizers (with equivalent N rate; NPKP, 50% N from pig manure; NPKC, 50% N from chicken manure). Crop yield, nitrogen use efficiency (NUE), soil fertility, N losses, and GHG emissions were chosen as prominent indicators to evaluate the consequences of manure substitutions for N-based fertilizers. The replacement of synthetic fertilizers by livestock manure decreased NO₃-N leaching and NH₃ volatilization by 46.2% and 5.61–22.2%, respectively, while sustained the crop yields and improved NUE. However, both NPKP and NPKC treatments did not have any impact on N₂O and CO₂ mitigation. Compared with NPK, NPKC and NPKP meaningfully increased SOC by 9.56% and 19.6%, respectively. More specifically, NPKC increased TN content by 14.7% ($P < 0.05$) compared to NPK treatment. The results showed that 50% substitution of manure for synthetic N fertilizers is a potential option in maize production systems to decrease N losses (including NH₃, N₂O emissions and N leaching) by approximately 45% (42.8–48.1%). However, only 1.81% of the total farmers surveyed (i.e., 16,595) have being applied livestock manure for maize

* Corresponding author.

E-mail address: zhailimei@caas.cn (L. Zhai).