frontiers | Frontiers in Environmental Science

TYPE Editorial
PUBLISHED 17 July 2023
DOI 10.3389/fenvs.2023.1254452

OPEN ACCESS

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RECEIVED 07 July 2023
ACCEPTED 11 July 2023
PUBLISHED 17 July 2023

CITATION
Zhang L, Liu H, Qin X and Liu J (2023), Editorial: Agricultural non-point source pollution and greenhouse gas: emission, control, and management.
Front. Environ. Sci. 11:1254452.
doi: 10.3389/fenvs.2023.1254452

Editorial: Agricultural non-point source pollution and greenhouse gas: emission, control, and management

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KEYWORDS

carbon, nitrogen, phosphorus, climate change, eutrophication, agricultural sustainability

Editorial on the Research Topic
Agricultural non-point source pollution and greenhouse gas: emission, control, and management

The migration and transformation of carbon (C), nitrogen (N) and phosphorus (P) in agroecosystems play an important role in global climate change, food security, and environmental protection and sustainability. Due to the influences of climate, landscape, soil and farming practices, agricultural non-point source (NPS) pollution and greenhouse gas (GHG) emissions are characterized by large spatial and temporal variabilities and lag responses to management, which challenge their monitoring, management and control (Van Meter et al, 2018; Sun et al, 2021). This Research Topic aims to increase our understanding of the processes driving agricultural NPS pollution and GHG emissions, discuss the challenges and opportunities associated with their monitoring, management and control, and provide scientific support for sustainable agricultural production.

Proper soil management can effectively improve soil health, reduce GHG emissions, and enhance food security (Williams et al, 2020; Murtaza et al, 2023). In a short-term study in a California vineyard, Wong et al reported effects of increasing compost application rates on soil C and GHG (N_2O and CO_2) emissions. The results pointed to the importance of investigating synergistic effects of combined practices on C sequestration and GHG mitigation to combat GHG emissions. In a meta-analysis of 870 paired observations from 75 peer-reviewed articles, Jia et al found that antagonistic and synergistic interactions dominated the responses of GHG fluxes, soil properties and crop yield to biochar and N additions. These findings indicated that the co-addition of biochar and N had the potential to mitigate climate change and improve yield, providing a valuable reference for the improvement of climate-smart agriculture.

Ammonia is an important N form in the cycle of N and significantly affects water and air quality. Consequently, there is a pressing need to explore options to removing ammonia from the environment. In an adsorption experiment, Li et al prepared modified activated C samples using three common inorganic acids (HNO_3, HCl and H_2SO_4) and investigated the effects of the active functional groups and residual acids on NH_3 adsorption to the acid-

modified activated C. The activated C modified by HNO_3 had the best NH_3 removal performance with the maximum NH_3 adsorption amounts of 40 mg g^{-1} over the 10M-HNO_3-90 sample. The results suggested that the modified activated C with more acidic oxygen-containing functional groups significantly elevated the NH_3 adsorption capacity for its further commercial applications.

Along with an increasing amount of evidence that small waterbodies help control NPS pollution in agricultural landscapes, the Research Topic of small waterbody protection and reduction of GHG emissions from such waterbodies have gradually been receiving research attention (Duan et al, 2023; Li et al, 2023; Shen et al, 2023; Xia et al, 2023). Zhou et al revealed that the asynchrony between urban expansion and water resource protection reshaped the spatial patterns of N and P concentrations and N:P stoichiometry in inland small waterbodies in Changsha, China. The results suggested that up-to-date urban water ecological management was essential to best protect the urban water environment in the process of urban expansion. Fan et al illuminated the influence of agricultural land use and pond management on the spatial-temporal variation of CH_4 and N_2O emission fluxes from pond systems in a subtropical agricultural headstream watershed. The results suggested that small waterbodies such as ponds should be considered when evaluating the potential of the aquatic system in reducing CH_4 and N_2O emissions and mitigating global warming.

Pesticides have been applied worldwide to control plant diseases and pests and increase agricultural productivity, however, they are recognized as a key threat to the United Nations' Sustainable Development Goals due to their environmental consequences (Zhang et al, 2022). The contamination of non-target areas via spray drift represents an adverse side-effect. Prechsl et al analyzed pesticide residue data collected in a monitoring program in Northern Italy to study the association of residue profile with spray drift. The results implied that improved farming practices represented an important leverage point for further spray drift reduction.

With the new knowledge presented in the collected papers, this Research Topic spans the current state of the science on agricultural NPS pollution and GHG emissions. Especially, it helps improve our knowledge of NPS pollution and GHG emission characteristics and controlling mechanisms at various temporal and spatial scales, and of the development and application of monitoring, modeling, controlling approaches as well as management strategies.

Author contributions

All authors have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Funding

The Research Topic and the Editorial were financially supported by the National Natural Science Foundation of China (U21A2025) and the Norwegian Institute of Bioeconomy Research's internal projects.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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