TYPE Editorial
PUBLISHED 26 October 2022
DOI 10.3389/fsufs.2022.1055636

Editorial: Innovative agricultural practices to improve soil health and sustain food production

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KEYWORDS

soil health, food security, nitrogen use efficiency, bio-stimulant, nanoremediation, sustainable agriculture

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OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Agroecology and Ecosystem Services, a section of the journal Frontiers in Sustainable Food Systems

RECEIVED 28 September 2022
ACCEPTED 03 October 2022
PUBLISHED 26 October 2022

CITATION
Sintim HY, Shahzad K and Yin X (2022) Editorial: Innovative agricultural practices to improve soil health and sustain food production. *Front. Sustain. Food Syst.* 6:1055636. doi: 10.3389/fsufs.2022.1055636

Editorial on the Research Topic
Innovative agricultural practices to improve soil health and sustain food production

Soil health is integral to sustainable agriculture, and it is one of the keys to increasing the resilience of food production to environmental stresses (Pozza and Field, 2020; Sintim et al., 2021). Soil health is commonly defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans (USDA-NRCS, 2012). It is assessed by measuring a variety of soil properties (physical, chemical, and biological properties), which must be interpreted based on ecosystem and intended soil use, as well as the season and climatic conditions, as depicted in Figure 1. For instance, while a soil pH of 6 to 7 is ideal for several crops, there are soil-acidic loving crops, such as blueberries. Thus, soils with a pH of 6 to 7 may not be considered as healthy for blueberry plantations, highlighting the need to interpret soil health based on its capacity to function in a given context.

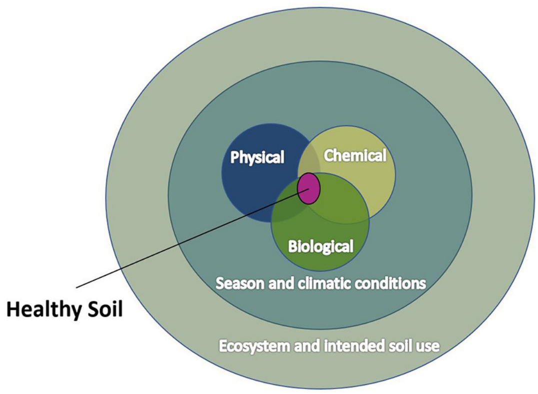

FIGURE 1
Schematic showing healthy soil is based on the interaction of physical, chemical, and biological properties within a specified ecosystem and intended soil use, as well as season and climatic conditions.

Soils serve several functions for crop productivity, including physical support, biodiversity & habitat, nutrient cycling, water flow & storage, and filtering & resilience (Andrews et al., 2004; Sintim et al., 2019). Given the current concerns around food production in the context of climate change, extensive research and outreach efforts must be focused on building soil health and sustainably producing food (IPCC, 2019; Pozza and Field, 2020; Shahzad et al., 2022). It is also important to identify the scientific, social, and economic barriers to the adoption of sustainable management practices. This Research Topic consists of four articles that advance current knowledge on the benefits and socio-economic factors of soil health improvement in sustainable food production.

Udvardi et al. featured an extensive literature review on N use efficiency in food production to identify opportunities for achieving responsible and sustainable use of N in the future. Despite being an essential nutrient for food production, N has complicated implications for the environment if improperly managed (Mandal et al., 2016; Shahzad et al., 2019). Thus, the development of innovative agricultural practices is warranted to reduce N losses to the atmosphere and waters, while ensuring adequate N inputs for food production. Agronomy, plant breeding, biological N fixation, soil N cycling, and modeling were identified as opportunities to increase agricultural N use efficiency. The maximal impact from research and development will likely involve advances in all these areas. Besides the technical advances, social involvement is essential to achieve responsible and sustainable use of N. This includes expanding the farming objectives from focusing on crop yields and/or economic returns to including stewardship of the land and surrounding environment, which is crucial for sustaining food production and society.

Carey et al. examined the combined impacts of commercial inoculants and alkali-extracted "humic" products on rangeland forage productivity and quality, soil microbial biomass and community composition, and abiotic soil parameters. The findings showed that bio-stimulants could potentially be used to regenerate rangelands. Forage productivity and quality responded positively to the foliar application of biological products. However, the benefits were not well-mirrored by changes in microbial community or abiotic parameters belowground. Schmidt et al. featured a research article that assessed how nematode metabolic footprint can be used to predict the resilience of peas toward root pathogens. The continuous cultivation of legumes in the cropping system promotes the existence of soil-borne pathogens that affect the legume's nitrogen-fixing ability by disturbing root growth and development. The authors studied free-living nematode communities in soils of organically managed agroecosystems with conventional tillage and non-inversion tillage. The soils were further tested in a greenhouse environment to assess the suppression of pea root rots caused by *Didymella pinodella*, *Fusarium avenaceum*, and *F. redolens*. Overall, pea root rot disease severity correlated negatively with the metabolic carbon footprint of nematodes, which were elevated in non-inversion tillage systems. The findings of the study highlight biological soil health as a critical factor in reducing disease prevalence in agricultural production. The authors also noted the need to extend the prediction of soil health from nematode metabolic footprints to other agroecosystems.

Heavy metal contamination of agricultural land is a concern because of increased industrialization. Phytoremediation has many advantages and it is a promising technology to treat heavy metal-contaminated soils. However, unpredictable remediation efficacy, due to variable weather conditions, as well as phytotoxic effects resulting from excessive heavy metal contaminants, preclude the widespread use of phytoremediation. Mathur et al. featured a review article on the use of nanoparticles in treating soils contaminated with heavy metals. The review highlighted nanoremediation as a potential technology to clean up large contaminated sites and reduce clean-up time. The authors noted the need to manipulate nanoparticle size and geometry to enhance remediation potential. They also mentioned the need to address constraints associated with the use of biologically derived nanoparticles in heavy metal remediation.

We hope this Research Topic of articles on emerging agricultural practices and ways to sustain food production will be useful to scientists, agricultural educators, government regulators, and other relevant stakeholders of food production. We also hope that they will serve as a good course on a global scale to help mitigate the degradation of soil health.

Author contributions

Conceptualization, writing-original draft, and writing-review and editing: HS, KS, and XY. All authors contributed to the article and approved the submitted version.

Acknowledgments

We like to acknowledge the editors of Frontiers in Sustainable Food Systems - Agroecology and Ecosystem Services for giving us the opportunity to guest edit this Research Topic. We also acknowledge all authors that contributed to the topic. A special thanks also go to the support staff of the journal for their tremendous help throughout the process.

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.

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