frontiers | Frontiers in Sustainable Food Systems

TYPE Editorial
PUBLISHED 11 December 2024
DOI 10.3389/fsufs.2024.1507692

OPEN ACCESS

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RECEIVED 08 October 2024
ACCEPTED 02 December 2024
PUBLISHED 11 December 2024

CITATION
Li Z, Li Y, Yao B and Carmona C (2024) Editorial: Optimising management practices to secure grassland agroecosystems' sustainability.
Front. Sustain. Food Syst. 8:1507692.
doi: 10.3389/fsufs.2024.1507692

Editorial: Optimising management practices to secure grassland agroecosystems' sustainability

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KEYWORDS

soil microbe and function, genetic diversity, forage quality, carbon sequestration, farmer behavior

Editorial on the Research Topic
Optimising management practices to secure grassland agroecosystems' sustainability

Globally, the escalating and diverse pressures on natural and modified ecosystems urgently necessitate a paradigm shift in agricultural practices. In this new paradigm enhancing soil health and biodiversity is pivotal to guarantee global food security. Traditional agricultural systems, while effective historically, have shown limitations in sustaining productivity and ecological balance under contemporary societal challenges. This is especially true for grassland agroecosystems, which are vital for sustainable agriculture due to their ability to improve soil health, sequester carbon, and support biodiversity.

Grassland farming, integrating grasses and legumes, offers multifaceted benefits, such as reducing soil and water erosion, providing high-quality livestock feed, enhancing soil fertility, and facilitating carbon sequestration. These advantages are critical for ensuring the productivity, sustainability, and resilience of agroecosystems, particularly in the face of climate change.

This Research Topic aims to address the urgent need for optimized management practices in grassland agroecosystems to ensure sustainable agriculture and efficient resource use. The focus includes strategies like how management of grassland forage genetic diversity, grazing-density, and fertilizer application can help mitigate climate and environmental change and augment soilmicrobial diversity, tolerance, and soil function. This Research Topic seeks to answer critical questions on the adaptability and resilience of these systems.

The Research Topic comprises 17 articles, which explore several key areas:

1. Soil microbial communities and environmental stressors:

One study explores the effects of short-term drought and nitrogen application on soil microbial communities in alfalfa (*Medicago sativa L.*) grasslands of the Chinese Loess Plateau, one of the largest plateaus in the world. The findings revealing significant changes in soil organic carbon components, enzyme activity, and microbial diversity (Wang et al.). Another article investigates the influence of grazing densities and topographical positions on soil biochemical and microbial properties of mixed-grass prairie ecosystem in the North Dakota of the United States, highlighting the importance of intermediate grazing density for enhancing soil health and microbial activity (Bansal et al.). Another study examines the influence of nitrogen input forms and rates on phosphorus availability in karst grassland soils, underscoring how specific nitrogen forms impact soil phosphorus availability, plant root biomass, and enzyme activity, essential for sustainable nutrient management in these sensitive ecosystems (Zhou et al.).

2. Genetic diversity and grassland plant tolerance:

Research on the genetic diversity and salt tolerance of 51 alfalfa varieties under saline soil conditions in eastern China demonstrates significant genetic variation and identifies specific varieties with strong tolerance, providing a basis for improving saline-alkali land management (Fan et al.). In another study, the agronomical characters of alfalfa in acidic soils in southwest China identified varieties with excellent total dry weight and fresh weight, offering insights for developing alfalfa strains resistant to acidic soil conditions (Tian et al.). Additionally, an analysis on *Bacillus amyloliquefaciens* PG-4 inoculation in *Macrotyloma uniflorum* demonstrates improved salt stress tolerance, highlighting PGPR's role in enhancing plant resilience under abiotic stresses, crucial for fodder crops in marginal soils (Wu et al.).

3. Soil function and forage quality:

Studies on tropical range grasses in semiarid degraded lands and the effects of oat (*Avena sativa L.*) -pea (*Pisum sativum L.*) seeding ratios on the Qinghai-Tibetan Plateau highlight the potential of these practices to sustain soil functions, such as nutrient cycling and soil fertility, through improved nutrient availability, and improve silage quality, respectively (Liu et al.). An analysis of the productivity, water, and nitrogen utilization of intensified dryland farming with annual forages on the Chinese Loess Plateau suggests that integrating forage crops, such as forage rape and common vetch, into cropping systems can enhance soil fertility by increasing nitrogen retention and availability, and crop productivity (Deng et al.). Another study demonstrates how soil functionality is influenced by the plant maturity stage in a grass-legume system, noting significant nitrogen loss reduction measures for stages when nutrient cycling slows, which could inform better nitrogen management (Xie et al.). Research on a green manure-maize rotation on the Yunnan-Guizhou Plateau indicates that leguminous amendments like alfalfa and common vetch significantly boost maize yield, nitrogen use efficiency, and phosphorus use efficiency, underscoring the agronomic benefits of integrating legumes into maize systems (Gao et al.). Further research on tropical range grasses in semiarid degraded lands shows that certain species, such as Tri-Specific Hybrid (TSH) and Heteropogon contortus, exhibit resilience in sustaining soil functions despite nutrient depletion, emphasizing the role of unmanaged grass cover in maintaining carbon accumulation and nutrient cycling in degraded soils of the Bundelkhand area in India (Patidar et al.).

4. Carbon sequestration and climate mitigation:

The carbon balance of boreal legume grasslands in Finland under different management practices highlights the importance of organic fertilizers in enhancing carbon sequestration and sustaining ecosystem services, such as soil fertility, nutrient cycling, and climate regulation (Li et al.). Comparative analyses of lucerne termination methods using herbicides, rather than traditional tillage on the Loess Plateau demonstrate the effectiveness of herbicides in maintaining soil carbon and nitrogen contents, providing alternatives to conventional tillage (Zhao et al.). Additionally, Kentucky bluegrass studies in varying plantation ages in the Qinghai-Tibetan Plateau of China have revealed dynamic changes in plant and soil C:N:P stoichiometry, indicating that established pastures over 6 years can better support nutrient cycling and soil quality, critical in carbon sequestration efforts (Wei et al.).

5. Farmer behavior and risk management:

A study on the influence of risk preferences on forage planting behaviors among farmers in China's agro-pastoral zone highlights the role of risk management in promoting sustainable forage cultivation (Zhang et al.). Another article exploring crop-livestock integration demonstrates a system for resource efficiency and livelihood improvement, offering a model with greater nutrient cycling, reduced emissions, and enhanced food security for smallholders in vulnerable regions (Shanmugam et al.). Additionally, research on forage yield, competition, and economic indices of oat and common vetch intercrops in a semi-arid region provides insights into optimizing intercropping ratios for maximum productivity and economic return, supporting resource-efficient agricultural practices in water-scarce environments (Jiao et al.).

The findings in these articles highlighting the role of plant diversity in grassland agroecosystems, demonstrating that integrating legumes into grass-based systems can contribute to the development of sustainable agricultural practices that are resilient to environmental changes, improving soil function, and helping meet the growing demands for food security and soil health. We would like to extend our gratitude to all authors, reviewers, and editorial team members for their dedication and expertise, which have made this Research Topic possible.

Author contributions

ZL: Conceptualization, Writing – original draft. YL: Conceptualization, Writing – review & editing. BY: Writing – review & editing. CC: Writing – review & editing.

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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