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Editorial: Livestock production and the functioning of agricultural ecosystems, Volume II

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Editorial on the Research Topic
Livestock production and the functioning of agricultural ecosystems, Volume II

Animal agriculture is vital to human food systems because only one-third of the agricultural land on earth can produce crops on a large scale, and much of the earth is rangeland that provides forage for livestock who can provide meat for humans (World Bank, 2021). While some argue red meat is bad for human and environmental health, there is little evidence for adverse effects of meat on human health (Lescinsky et al., 2022), and much evidence an omnivorous diet is more nourishing than diets that severely limit or exclude either animal or plant foods (van Vliet et al., 2020). While meat is important for human nutrition, animal agriculture can adversely affect plant diversity and soil health and contribute to greenhouse gas emissions (Kleppel, 2020). Yet, livestock can also positively influence biodiversity and ecosystem processes with properly managed grazing that fosters the ongoing coevolution of herbivores and plants. In Volume II of *Livestock Production and the Functioning of Agricultural Ecosystems,* we emphasized ways livestock can enhance the health of soil, plants, livestock, and humans.

Plant diversity nourishes life below and above ground thus enhancing biodiversity, which is an essential element of the regenerative agriculture movement in food production, carbon sequestration, water filtration, and nutrient cycling. Plant diversity is vital for the life of the soil microbiome, which is responsible for mediating 90 percent of soil functions (Furtak and Gajda, 2018). Multi-species rotational grazing (MSRG) is a promising way to maintain and improve plant diversity and the health of life below and above ground, yet the potential effects of MSRG on ecosystems are poorly understood.

To help address this knowledge gap, Mhuireach et al. studied the effects of four grazing treatments—cattle only, sheep only, swine only, or multi-species grazing—on soil microbes in 12 paddocks (three paddocks/treatment) at three times in the 2020 grazing season. They showed wide diversity in the microbiomes of all soils, though paddocks grazed by sheep were more like multi-species paddocks than were paddocks grazed only by cattle or swine. This novel study shows that grazing different species of livestock, either separately or together, can positively impact soil microbial community structure.

Grazing by livestock can enhance or diminish the biodiversity of plants and animals. Dumont et al. developed indicators to evaluate how grazing by livestock and grassland management can influence biodiversity in the insect communities of grassland ecosystems. Importantly, these indicators can be assessed for any grassland where botanical composition of plants and management practices are known, and they do not require sophisticated knowledge of entomology or conservation biology.

Different plant species vary temporally and spatially in energy, protein, vitamins, and minerals as well as diverse arrays of secondary compounds (SC) with nutritional, medicinal, and prophylactic properties. Knowledge of SC and their distribution in the landscape can enhance the design and implementation of healthier foodscapes for ruminants. Pereira and Gregorini show how Geographic Information Systems (GIS) can be used to assess the spatial distribution of SC-rich plants thus enabling people to visualize potential healthscapes for ruminants. The maps they created of botanical composition and advanced image classification show the distribution of SC in plants in ways that enable graziers to make better grazing management decisions for more productive, sustainable, and healthy grazing systems.

Garrett et al. found that providing ewes with spatially separated strips of ryegrass, chicory, plantain, red clover, and alfalfa improved antioxidant status and reduced some markers of oxidative and metabolic stress at lambing compared to a conventional ryegrass-only diet. Diet diversity thus reduced stress and improved lamb birth weights relative to ewes offered only one forage species. Plant diversity in livestock diets, in turn, enhances the quality of meat and dairy for human consumption (van Vliet et al., 2021).

In Europe, where consumption of animal protein exceeds dietary guidelines in most countries, some contend that rebalancing between animal and alternative protein sources in diets will mitigate the alleged harmful effects of cattle production and induce healthier human diets. In a study in Wallonia, Belgium, Duluins et al. found that, for dairy farmers, reduced herd size, higher share of pastures, and increased concentrate autonomy are correlated with lower operating costs, resulting in higher economic margins. For the beef sector, however, these farm characteristics were not correlated with most economic indicators, but they were highly associated with increased subsidies. Their findings suggest that changes in the beef sector will be induced by policy choices rather than by economic factors.

Growing interest in restoring functionality to agricultural grazing ecosystems has evolved along with data documenting the adverse impacts of "conventional" animal agriculture. So-called "regenerative" protocols seek to mimic the structure and function of wild grazing ecosystems. Kleppel and Frank reviewed literature on the structure and key functional attributes of wild and agricultural grazing ecosystems. They found grazers can increase or decrease functionality, depending on environmental conditions such as moisture, and that biodiversity, nitrogen cycling, and carbon storage in regenerative grazing systems more closely resemble wild than conventional grazing systems. They also found multiple points of disagreement in the literature, mainly regarding aboveground primary production. Some of the variability in the studies, especially meta-analyses, might be reduced if datasets included greater detail on grazing protocols and a common definition of the term "grazing intensity." They conclude that, while much has been accomplished in understanding grazing ecosystems, much remains to be learned.

In the end, volume II identifies gaps in our understanding of animal agriculture and livestock management, and more importantly offers novel approaches that can help fill some of these gaps and, hopefully, inspire innovative practices and further research. Most papers address the importance of biodiversity in agricultural ecosystems and the connectivity that influences the functionality and health of ecosystems at all levels, from microbes to plants to animals, including insects, all integral components of grazing ecosystems. The crucial message that emerges from this issue is that biodiversity, from microbes in soil to plant communities to herbivore diets, is seminal to the functioning of agricultural ecosystems, and therefore, vital to our own wellbeing. As scientists we must celebrate biodiversity, we should seek to better understand it, and we need to explore new avenues to enhance and protect it.

Author contributions

FP wrote the original draft of the editorial. GK and JV added useful suggestions. All authors contributed to the article and approved the submitted version.

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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