soil systems

Editorial

Research on Soil Management and Conservation

Luis Eduardo Akiyoshi Sanches Suzuki

Center of Technology Development, Federal University of Pelotas, Pelotas 96010-610, Rio Grande do Sul State, Brazil; dusuzuki@gmail.com

The soil is the base of a sustainable agricultural system; it is the key for food and energy production, a reservoir of water and nutrients [1–3], and a filter for water and contaminants [4]. However, inadequate soil management may significantly negatively impact the environment [5–7], crop development and yield [8–12], natural resources such as air and water [13–15], and human and animal health [16,17]. Soil management practices that favor soil and water conservation and the improvement of soil functions and structure are preferable. The diversity of soil uses and types [18–20], climate [21], relief, and origin materials make the study of better soil management practices a worldwide challenge. Thus, the Special Issue "Soil Management and Conservation" addresses topics such as soil tillage, the influence of machinery on soil structure, erosion processes, control practices, the influence of plants on soil structure, and practices used for soil conservation and the improvement of soil structure. Strategies to avoid soil structure degradation, such as studies on precompression stress and the compression index, were called upon to present the new findings on that subject.

In this sense, we had the response of the scientific community, presenting their findings in this Special Issue. The transition from irrigated cropland to irrigated management-intensive grazing (MiG) as a proposal to sustainably intensify agroecosystems was evaluated through soil health indicators using the Soil Management Assessment Framework (SMAF) and verified to have significant improvements in biological soil health indicators such as β-glucosidase, microbial biomass carbon, and potentially mineralizable nitrogen, while nutrient status was relatively stable (Trimarco et al., Contribution 1). On the other hand, the authors verified that soil compaction, based on bulk density, reduced soil physical health. In this context, the soil structure can be very susceptible to compaction, requiring attention to machinery traffic and animal trampling, especially for loads larger than the precompression stress that can overcompact the soil, despite the fact that loose soil is more compressive, presenting greater deformation than a preserved soil structure (Suzuki et al., Contribution 2).

Our Special Issue also brought an alert to the effects of polyethylene polymer on soil properties and plant growth, showing that the presence of polyethylene polymer on microplastics in the soil may increase the amount of available Zn and Cd in highly contaminated soils and lettuce and edible leaves, posing a risk to the environment and human health (Bethanis and Golia, Contribution 3). We highlighted the challenges in the management of environmentally fragile sandy soils, showing these soils play an important role in aquifer recharge, but they are soils of low suitability for agricultural use and with a high risk of leaching and aquifer contamination (Suzuki et al., Contribution 4).

Studies on soil management and conservation were presented in the Special Issue, showing the no-tillage system maintains soil carbon in the deepest soil layers, but the loss of carbon rate in the topsoil is greater than the input due to soil erosion and organic matter mineralization (Thomaz and Kurasz, Contribution 5), while green manure together with grass is an economical and environmentally sound strategy to restore the macrofauna of an anthropogenically degraded soil (Bonini et al., Contribution 6). The adoption of conservation agriculture principles such as conservation tillage, permanent plant cover, and crop

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diversification can contribute to the mitigation of climate change without compromising food security on local and global scales, but knowledge about biophysical, technical, socio-economic, cultural, and political barriers is still necessary since the success of the adoption of conservation agriculture practices will depend on environmental–socio-economic factors (Francaviglia et al., Contribution 7). In this line, conventional and organic management did not significantly affect the decomposition rate of soil organic matter in cranberry soils but varied with soil layer, incubation time, and temperature, with the rate of CO_2 emissions decreasing with elapsed time and the soil subsurface contributing increasingly to CO_2 emissions (Dossou-Yovo et al., Contribution 8). Combinations of multiple conservation management practices, such as crop residues, cover crop planting and termination timing, seeding rate or species selection, tillage practices, and organic amendments such as manure and compost, which affect soil water and nutrient dynamics, may improve soil water functions (Ghimire et al., Contribution 9).

Models based on machine learning algorithms were used to understand the geographical distribution of gully erosion and identify regions more prone to gully formation to ensure appropriate management (Eloudi et al., Contribution 10). We also presented that the use of oat straw mulching decreased soil runoff, and the cost to replace the available nutrients via mineral fertilizer varies from USD 75.4 (no mulching) to USD 2.70 per hectare (8 Mg ha^{-1} oat straw mulching) (Suzuki et al., Contribution 11), showing the efficiency of conservation practices in decreasing soil runoff. In this same way, it was verified that the integration of GIS-based analyses with hydrological modeling at watershed scales provides additional capabilities to quantify the effect of conservation practices on sediment loads by spatially characterizing different types of conservation practices and scenarios and their relative impact on sediment reduction (ElKadiri et al., Contribution 12). The water erosion processes caused by intensive soil trampling on the tourist trails were also contemplated in this Special Issue, indicating strategies for appropriate management and recovery of the degraded trails and avoiding accidents involving visitors (Lima et al., Contribution 13).

In terms of soil functioning and behavior, we should consider that continuous wetting and drying soil cycles may influence water retention, water holding capacity, and water movement (Pires, Contribution 14). Moreover, the soil amendments with biochar and silica have the potential to reduce the adverse effect of salt stress on cucumber (Al-Toobi et al., Contribution 15), which is a strategy to improve the soil environment for crop growth and yield.

Future research was pointed out in this Special Issue, such as quantifying net carbon accumulation in cranberry soils through litter burial by sanding and the development of methodologies for site sampling and monitoring of the cranberry production system to meet sustainable development goals for emissions (Dossou-Yovo et al., Contribution 8). The need to develop region-specific, stakeholder-driven approaches for a more reliable estimate of soil health in water-limited environments like arid and semi-arid regions of the USA, since the indicators or weighting of them may differ from more humid regions or according to climate context (Ghimire et al., Contribution 9). The soil organic carbon content can be a good indicator of the effectiveness of the adoption of a certain conservation agriculture practice, considering its agro-environmental benefits and its potential for climate change mitigation, despite the fact that studies are necessary to accurately assess soil organic carbon (SOC) gains and address the limitations of soil organic carbon sequestration, especially the uncertainty associated with SOC estimations at the farm level (Francaviglia et al., Contribution 7).

Soil and site-specific studies are necessary to define the soil moisture needed to remove animals from wet soils to reduce or avoid soil compaction caused by hoof pressure (Trimarco et al., Contribution 1), as well as the knowledge of the precompression stress values and their relationship with soil structure to avoid additional compaction caused by machinery traffic and animal trampling (Suzuki et al., Contribution 2).

Further studies are still necessary to understand the mechanisms that catalyze the synergistic toxicity of the coexistence of metals and microplastics in soils, which may pose risks to soil, plants, and human health, and to find appropriate appointments to reduce such risks (Bethanis and Golia, Contribution 3).

Our Special Issue also reinforces the following: challenging application of study results to farmers, extension agents, and stakeholders, such as conservationist agriculture; mulching on the ground is kept; a crop rotation system is planned and not only a crop succession (e.g., wheat–soybean); replacement of fallow by cover crops; and usage of contour tillage and terraces wherever necessary (Thomaz and Kurasz, Contribution 5; Suzuki et al., Contribution 11); and challenges in the management of sandy soils (Suzuki et al., Contribution 4).

Models based on machine learning algorithms for determining the gully formation need further studies to test their performance under many subdivisions of the input data in order to improve the prediction (Eloudi et al., Contribution 10), as well as their applicability for identification of different types of practices, controlling parameters, and their location in the watershed to reduce sediment load (ElKadiri et al., Contribution 12).

Our Special Issue achieved, directly or indirectly, at least some of the 17 sustainable development goals (SDGs) [22], especially the goals (2) zero hunger, (6) clean water and sanitation, (13) climate action, and (15) life on land. Goal (2) zero hunger: The papers present strategies to improve the soil environment for crop growth and yield, although more food yield does not mean equal distribution and access. Goal (6) clean water and sanitation: Includes improving soil quality, reducing the input of sediments into the water, and maintaining clean water. Goal (13) climate action: Some papers approached carbon sequestration, which meets the climate action to combat climate change and its impacts. Goal (15) life on land: Some papers met the actions to protect, restore, and promote sustainable use of terrestrial ecosystems.

The Special Issue "Soil Management and Conservation" presented some advances and contributions to the knowledge of some topics addressed and indicated the possibility for future research.

Conflicts of Interest: The author declares no conflicts of interest.

List of Contributions

1. Trimarco, T.; Brummer, J.E.; Buchanan, C.; Ippolito, J.A. Tracking soil health changes in a management-intensive grazing agroecosystem. *Soil Syst.* **2023**, *7*, 94. https://doi.org/10.3390/soilsystems7040094.
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