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THEME: REGENERATIVE PRACTICES

CCARBON
CENTER FOR CARBON RESEARCH IN TROPICAL AGRICULTURE
UNIVERSITY OF SÃO PAULO

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How does soil health influence ecosystem restoration?

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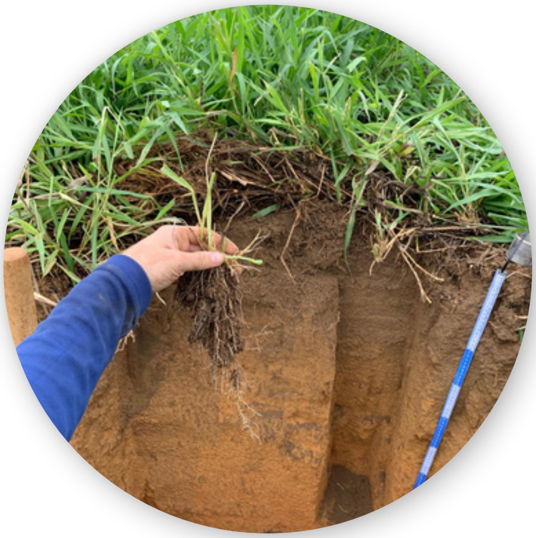
REGENERATIVE PRACTICES

Regenerative agriculture seeks to support and enhance what soil naturally is: a living, fertile system full of essential interactions.
Through practices such as no-till farming, crop rotation, green manure and cover crops, crop-livestock-forest integration systems, and reduced soil disturbance, we strengthen natural processes, promote biodiversity, and maintain ecosystem vitality.
In this edition, we show how these regenerative practices support soil in its vital functions, from carbon storage and moisture retention to nutrient cycling and the resilience of production systems in the face of climate change.
Talking about regeneration means recognizing the importance of cultivating an agriculture that respects the soil, ensuring food security, environmental preservation, and quality of life for future generations.

Enjoy the read!

Victória Santos Souza



Larissa de Souza Bortolo

Crop rotation with Species Diversification During Off-season Impact the Nutrient Cycling in No-tillage System

Andressa Selestina Dalla Côrt, Leandro Pereira Pacheco, Thaís Rodrigues Magalhães Guedes, Laércio Santos Silva, Tassia Maira Greco, Kamila Silva de Macedo, Eder Rodrigues Batista, Edicarlos Damacena de Souza, Izabela Aline Gomes da Silva, Carlos Alexandre Costa Crusciol

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In the 2020/2021 growing season, Brazil consolidated its position as the world's largest soybean producer and exporter, reaching 136.9 million tons, of which 83 million were destined for the international market. These figures represented a significant share of global soybean production, estimated at 362.9 million tons (Conab, 2021; FAO, 2021). In this scenario, the development of sustainable production systems becomes essential to mitigate environmental impacts, reduce carbon emissions, optimize water and energy use, and increase agricultural productivity (Embrapa, 2021).

The no-till system is one of the most well-established practices in this context. Adopted on more than 33 million hectares in Brazil, it is based on three fundamental principles of regenerative agriculture: minimal mechanical soil disturbance, permanent soil cover, and crop diversification with living plants throughout the year. Its main benefits include increased efficiency in the soil–plant–atmosphere system and improved soil fertility and conservation.

One of the major challenges of no-till farming is crop diversification. The succession predominant soybean–maize succession, although widely used and economically advantageous, reduces the biological diversity of the system. The inclusion of annual crops and cover crops in intercropping systems emerges as a promising alternative within a systemic approach to soybean production.

The use of cover crops favors nutrient cycling, increases soil organic matter, and enhances the resilience of agricultural production. However, producer acceptance remains an obstacle to the adoption of crop rotation, since it may require replacing commercial crops with cover crops in certain years. In addition, it is necessary to select species adapted to local conditions, avoiding economic losses and ensuring productive stability.

To meet the demand for sustainable agricultural systems capable of restoring soil quality in the Cerrado, this study evaluated the performance of cover and annual crops during the off-season in diversified and conservation-based succession systems. Biomass production and accumulation were analyzed, as well as nutrient cycling

nitrogen (N), phosphorus (P), and potassium (K) over five years of cultivation.
The experiment was conducted in Rondonópolis, Mato Grosso, Brazil. Soybean was grown in all experimental units during the summer growing season, while cover crops were cultivated during the off-season, either as monocultures or intercropped systems.
The treatments were: monoculture 1 under conventional tillage (MC1); monoculture 2 under fallow in a no-till system (MC2); crop succession with Crotalaria spectabilis (CS1); succession with Pennisetum glaucum (CS2); succession with Urochloa ruziziensis (CS3); succession with Cajanus cajan (CS4); maize intercropped with C. spectabilis (IC1); maize intercropped with U. ruziziensis (IC2); and a species mixture (C. spectabilis + P. glaucum + U. ruziziensis + C. cajan) (MIX) (Figure 1).

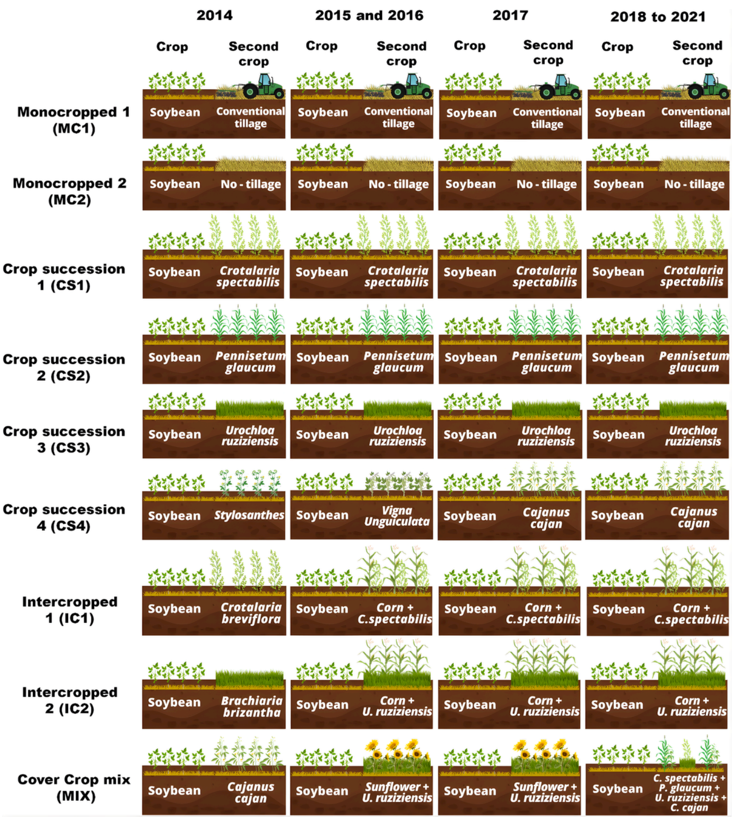

Figura 1. Composição dos sistemas de cultivo nos anos agrícolas de 2014/2015 a 2018/2021.

The systems with greater cover crop diversity (IC1, IC2, and MIX) showed the highest biomass accumulation. The cover crop MIX stood out for its high productivity, reflecting the efficiency of intercropping species and the use of water and energy resources, which resulted in greater plant tissue formation.
Treatment CS3 also stood out due to the regrowth of Urochloa ruziziensis during the off-season, demonstrating a high capacity to increase biomass production under no-till systems. The presence of this grass, combined with the diversity of the MIX, reinforces a more resilient and sustainable agricultural model. This performance results from the complementarity of phenological cycles and perennial growth habits, which keep the system active throughout the off-season, increasing the efficiency of CO_2 incorporation into biomass and soil.
The decomposition half-life ranged from 68 to 88 days, being shorter in CS1, longer in IC1, IC2, and CS3, and intermediate in the MIX composed of grasses and legumes. These results highlight the role of diversified systems in forming the particulate fraction of soil organic matter (SOM), which is fundamental for microbial activity and nutrient cycling. Legumes, such as C. spectabilis, showed faster decomposition due to their high N content derived from biological nitrogen fixation (BNF) and their lower C/N ratios.
Regarding nitrogen contents, treatment CS3 stood out, accumulating approximately 110 kg ha^{-1} $year^{-1}$. In the IC2 and MIX intercropping systems, greater N retention and slower release were observed, reflecting the composition of the species. In systems with legumes, such as CS4 (Cajanus cajan), accelerated leaf decomposition favored rapid N release, whereas in systems composed only of grasses, such as CS3 (U. ruziziensis grown alone), N release was more gradual.
The diversity of the MIX increased the heterogeneity of root exudates, promoting a more diverse and active microbiota capable of transforming biomass into labile organic matter. This process favored greater N mineralization and improved nutrient availability for

subsequent crops.

Regarding phosphorus, CS3 showed concentrations three times higher than the other treatments, with rapid release, followed by the MIX, which released P more slowly. Systems with U. ruziziensis showed high P concentrations, associated with its capacity to mobilize recalcitrant forms of this nutrient from deeper rhizosphere layers through the exudation of organic acids and symbiotic interactions with fungi and bacteria. This mechanism increases labile P in the surface layers, favoring its recycling through residue mineralization and promoting nutritional synergy within the system.

For potassium, the MIX showed the highest accumulation, with rapid release, similar to CS3. In contrast, MC1 and MC2 recorded the lowest values of N, P, and K. Sunflower, present in the MIX intercropped with U. ruziziensis, contributed substantially to total K accumulation due to the high concentration of this nutrient in stems and petioles. The combination of taproot and fibrous root systems proved highly efficient in extracting K from deeper soil layers and translocating it to the shoots, increasing nutrient inputs into the biomass. Among the evaluated nutrients, K showed the highest release rate, with up to 50–60% of the total returning to the soil between 40 and 45 days after desiccation.

Regarding soybean yield, C. spectabilis provided the best results. Treatment CS1 was the most productive, with an increase of 655.64 kg ha^{-1} $year^{-1}$ compared with the control, and all systems, except MC1 and CS4, showed significant gains. In years with occasional rainfall during the off-season, C. spectabilis (CS1) remained active through regrowth, promoting C and N fixation, root exudate release, microbial growth stimulation, and nutrient recycling.

Conclusion

The results demonstrate that the appropriate selection of species and the diversification of cropping systems directly influence nutrient cycling and soybean productivity through different ecological and physiological mechanisms. The regrowth capacity of Urochloa ruziziensis sustained N accumulation during the off-season, especially in intercropped and mixed systems, increasing nutrient availability for the subsequent crop. In these same systems, the rapid release of P was associated with the functional traits of Urochloa, which intensified nutrient return and organic matter mineralization.

The combination of species with complementary nutrient-cycling functions, observed in the MIX system, accelerated potassium release and promoted greater synchrony between nutrient supply and soybean demand. The consistent increase in productivity under Crotalaria spectabilis reflects its long-term contribution to soil fertility and the biogeochemical balance of the system.

Overall, these results reinforce that off-season species diversification improves nutrient cycling efficiency and represents an essential component for the sustainability and productivity of no-till soybean systems.

Read the full article!

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Biologist | Ph.D. in Agronomy

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Diversification with perennial forages increases soil carbon stocks and soybean productivity

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The protection and restoration of Soil Organic Carbon (SOC) are essential for climate change mitigation. Soil has the capacity to sequester atmospheric carbon (CO_2) through management practices that preserve soil health, thereby increasing carbon stocks and retaining them for long periods.

Conservation practices, such as no-tillage combined with the use of cover crops, promote substantial environmental and agronomic benefits. These practices can increase SOC stocks by up to 12% in conserved areas compared to fallow systems (bare soil), while also improving soil physical and chemical properties, including soil structure and nutrient cycling.

In Brazil, MATOPIBA — a frontier agricultural region encompassing the states of Maranhão, Tocantins, Piauí, and Bahia — has become an important agricultural hub. However, the region's climatic conditions are not favorable for soil carbon accumulation. High temperatures average annual temperatures around 25°C and a seasonal rainfall regime ranging from 1,000 to 1,900 mm per year accelerate organic matter decomposition. The absence of conservation practices in these tropical zones intensifies soil degradation, leading to physical deterioration and reductions in SOC stocks.

A promising alternative to reverse this process is crop diversification within soybean production systems. The inclusion of tropical grasses can increase not only soil carbon stocks but also soybean productivity. The integration of annual or perennial forages is an excellent strategy for conserving soil health. Due to their root architecture and physiology, these grasses contribute to aggregate stabilization and to the accumulation of organic matter at deeper soil layers.

Thus, this study hypothesizes that the incorporation of forages into soybean production systems can increase yield and SOC stocks. The objective was to evaluate the long-term effects of diversification with annual and perennial grasses on carbon stocks in the MATOPIBA region, while quantifying the impacts of these cover crops on soybean productivity. The results aim to contribute to the development of productive resilience, sustainable crop intensification, and climate change mitigation in tropical regions.

The experiment was conducted in Gurupi, Tocantins State, northern Brazil. For 10 years before the experiment was established, the land had been used as unmanaged pasture. Soybean was manually sown, while grasses were broadcast seeded, following the same cultivation and management practices during the subsequent cropping seasons from 2013/2014 to 2021/2022.

The treatments were: 1) Urochloa brizantha cv. Marandu (Ubm), 2) U. ruziziensis (Urz), 3) Megathyrsus maximus var. Mombaça (Mmb), 4) M. maximus var. Massai (Mms), 5) Pennisetum glaucum (Pgl), 6) fallow (Sfw), characterized by the presence of spontaneous plants typical of the region, and 7) extensive pasture area (PNom) with Urochloa spp., representing the previous land use.

The study found that 44% of total SOC stocks were stored in the upper 30 cm, while the remaining carbon was distributed in deeper layers (30–100 cm). Regardless of treatment, SOC stocks increased with depth. In the 0–30 cm layer, the highest C stocks were observed under U. brizantha cv. Marandu and M. maximus var. Mombaça, with 41.7 Mg ha^{-1} and 40.0 Mg ha^{-1}, respectively. These values correspond to an increase of approximately 15% compared with millet and 7% compared with fallow.

In the 0–100 cm layer, cultivation of M. maximus var. Mombaça resulted in the greatest increase in SOC stocks (94.3 Mg ha^{-1}), representing an increase of approximately 8.2% compared with the average of the other forage treatments. The highest soil nitrogen (N) stocks in the upper 30 cm were found under M. maximus var. Mombaça, reaching 3.1 Mg ha^{-1}, approximately 17% higher than the other forage treatments. In contrast, M. maximus var. Massai and millet showed the lowest N stocks, with 2.2 and 2.4 Mg ha^{-1}, respectively.

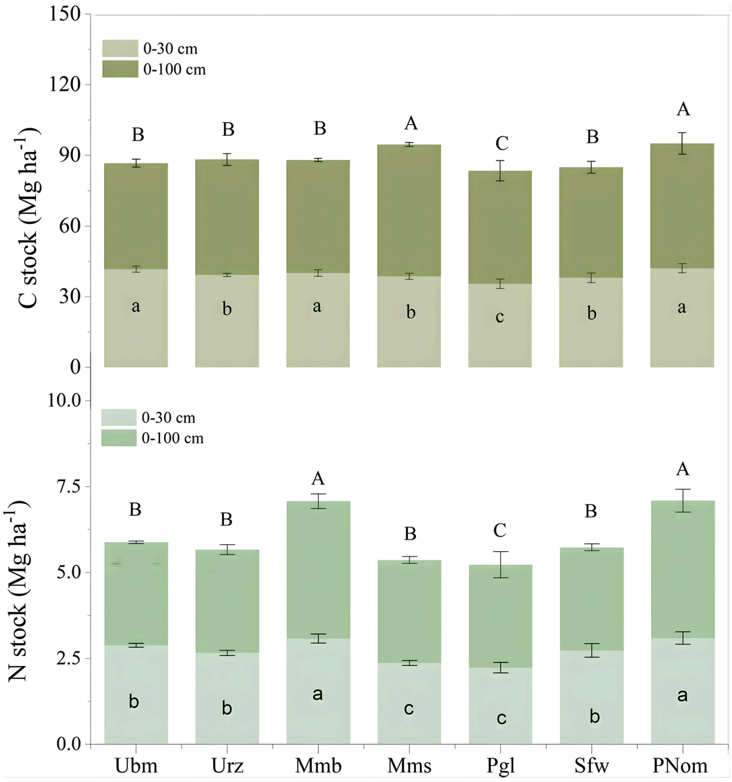

Figura 1: Estoques de C (A) e nitrogênio (B) no solo (0–30 e 0–100 cm) em soja com sobressemeadura de U. brizantha cv. Marandu (Ubm), U. ruziziensis (Urz), M. maximus cv. Mombaça (Mmb), M. maximus cv. Massai (Mms) e P. glaucum (Pgl), solo em pousio (Sfw) e pastagem nominal (PNom).

Soil isotope values in the surface layer (0–30 cm) ranged from −19 to −21‰, suggesting a mixture of C4 and C3 plant residues in soil organic matter. In contrast, isotope values of soil organic matter under nominal pasture ranged from −14 to −18 ‰, likely because there was no year-round enrichment from C3 plants.

In systems using four perennial forages (U. brizantha cv. Marandu, U. ruziziensis, M. maximus var. Mombaça, and M. maximus var. Massai), crop productivity averaged 4,142 kg ha^{-1}, representing an increase of 13 to 20% compared with millet and fallow systems (3,607 kg ha^{-1} and 3,275 kg ha^{-1}, respectively). The crop succession using millet did not positively affect soybean productivity compared with fallow.

A positive relationship was observed between forage biomass and SOC stocks in the 0–10 cm layer, indicating that higher forage biomass was associated with greater soil organic carbon storage. Biomass inputs and SOC stocks also contributed to increased soybean productivity, with an estimated gain of 128 kg ha^{-1} for each additional 1 Mg ha^{-1} of SOC.

The study confirmed the hypothesis that biodiversification increases biomass input, leading to greater SOC stocks, particularly in the surface soil layers.

Conclusion

The introduction of high-biomass perennial forage species, particularly from the genera Urochloa and Megathyrsus, increased soil carbon stocks down to one meter depth in the MATOPIBA region. In contrast, the continuous use of millet in the Cerrado led to small carbon losses over the years, particularly in the 0–30 cm layer, and did not increase soybean productivity to levels comparable with fallow.

Isotopic analysis ($\delta^{13}C$) confirmed that stabilized carbon originated mainly from soybean residues, likely due to their higher nitrogen content and greater microbial assimilation efficiency. The limited biomass production and short growth cycle of millet restricted its contribution to soil carbon accumulation under the region’s short rainy season and high temperatures.

These results reinforce the importance of integrating perennial forages into tropical grain production systems to increase soil carbon sequestration and soybean productivity. The use of these species offers a nature-based and climate-resilient alternative to climate change compared with conventional cover crops, especially under the challenging conditions of MATOPIBA.

For policymakers, this approach provides scientific support for sustainable intensification and adaptation programs. For farmers, it may improve long-term productivity while reducing dependence on external inputs. However, practical adoption may depend on factors such as cost, management effort, and seed availability, highlighting the need for further research to ensure scalability across tropical agroecosystems such as MATOPIBA.

Larissa de Souza Bortolo

Read the full article!

She holds a degree in Agronomic Engineering from the Federal University of Uberlândia (UFU) and an M.Sc. in Soils and Plant Nutrition from the "Luiz de Queiroz" College of Agriculture (USP/ESALQ). She was a member of the Soil Health Management Research Group (SOHMA) at ESALQ/USP.
She received the 2023 Outstanding Master's Student Award from the Research Centre for Greenhouse Gas Innovation (RCGI), nominated by the Nature-based Solutions (NBS) program, as well as the Victor Hugo Alvarez V. Soil Science Award (2025), granted by the Brazilian Society of Soil Science (SBCS) for being among the best theses and dissertations defended between 2023 and 2024 in Division III – Soil Use and Management.
She is currently a researcher at Fundação MT and a member of the Brazilian Soil Health Partnership.

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He holds a degree in Agronomic Engineering from the Federal University of Santa Maria (UFSM), a B.Sc. in Business Administration from the Federal University of Santa Catarina (UFSC), an M.Sc. in Agronomy, with emphasis on Agriculture and Environment, from UFSM, and a Ph.D. in Sciences, with a concentration in Soils and Plant Nutrition, from the "Luiz de Queiroz" College of Agriculture, University of São Paulo (ESALQ/USP). He completed postdoctoral training at the Center for Nuclear Energy in Agriculture (CENA/USP).
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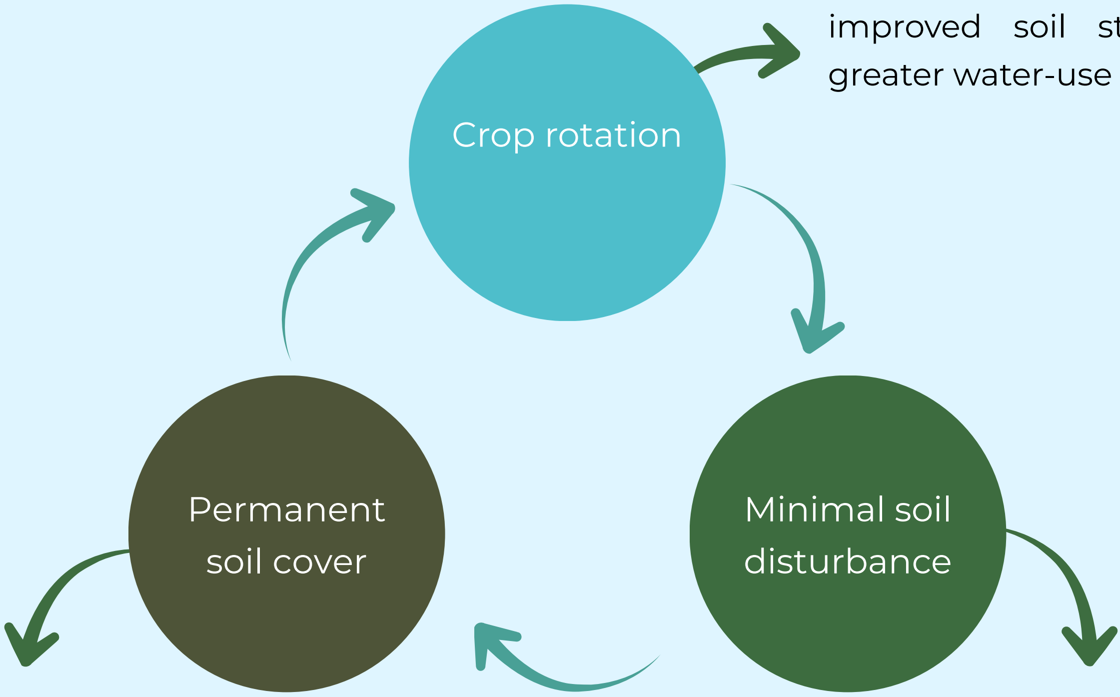
Maurício Roberto Cherubin
Professor at the "Luiz de Queiroz" College of Agriculture (ESALQ/USP)

In practice

The three pillars of No-Tillage System (NTS) and its benefits

Plant diversity; disruption of pest, disease, and weed cycles; improved soil structure; and greater water-use efficiency.



Increases soil organic matter, protects against erosion, regulates soil temperature, and improves overall soil health.

Conservation of soil moisture, physical and functional soil properties; increased soil organic matter; and improved soil structure.

Antônio Luis Santi

Federal University of Santa Maria (UFSM)

He is an agronomist with M.Sc. and Ph.D. degrees from the Federal University of Santa Maria (UFSM) and a member of the Brazilian Soil Health Partnership.

His main areas of expertise include:

- Precision agriculture;
- Field crops;
- Soil use, management, and conservation.

He has extensive experience in Precision and Digital Agriculture, with emphasis on georeferenced crop management, soil health, and sustainability. His work has greatly contributed to advancing knowledge on soil health in Brazil.

1)What motivated you to work with georeferenced soil and crop management?

I am the son of smallholder farmers from the municipality of Jaboticaba, in the northern region of Rio Grande do Sul, and the youngest of eight siblings. I studied in public schools throughout my education and had the privilege of entering the Federal University of Santa Maria (UFSM) in 1996 to study Agronomy, completing my degree in January 2000.
After graduating, in 2001 I began a master's degree in the Graduate Program in Crop Science, with an emphasis on Plant Production, also at UFSM, which I completed in early 2003. That same year, I started my Ph.D. in Soil Science at UFSM, supported by a scholarship from Fundação AGRISUS/FEALQ. In 2007, I defended my doctoral thesis entitled "Relationships between soil quality indicators and crop productivity in precision agriculture areas."
What first motivated me to work with agricultural technology was the opportunity to explore an innovative topic during my Ph.D. At that time, from 2003 to 2007, research on precision agriculture was just beginning in Brazil, and there was still no research or publication on the topic in southern Brazil. This gave me the opportunity to learn about the concepts, technologies, and methodologies of precision agriculture, as well as the management opportunities offered by georeferenced soil and crop management.
Instead of looking only at average values of soil and crop attributes, precision agriculture allowed us to understand spatial variability within the field. I had the privilege of helping conduct some of the first experiments in commercial farming areas in the municipalities of Palmeira das Missões and Não-Me-Toque, Rio Grande do Sul. These were pioneering precision agriculture areas in the state. I also had the opportunity to work in Project AQUARIUS, the largest and longest-running project

precision agriculture project in Brazil, helping to implement this technology in southern Brazil.

What strongly motivates us to work with georeferenced management is the possibility of improving field-level decision-making through detailed monitoring of the progress—or decline—of soil and crop attributes over time. For example, in the figure below, variable-rate phosphorus application helped improve soil P levels over time. However, maintaining the same crop succession system (wheat/soybean) led to a decline in soil organic matter, indicating a significant loss in soil health.

Working with technological tools for georeferenced soil and crop management has been an opportunity to contribute to innovation in Brazilian agriculture, to study and research a topic that was still new in Brazil, and to support an approach aimed at maximizing crop productivity, optimizing natural resources, and preserving the environment.

2) How do you see the contribution of georeferenced soil and crop management to sustainable soil management practices in Brazil?

Precision and digital agriculture techniques have great potential — and are perhaps among the most promising tools — for guiding sustainable soil management practices. First, because they account for spatial variability within fields, respecting their specific characteristics, limitations, and potential. Second, and perhaps most importantly, they make it possible to manage different areas in different ways: applying exactly the required amount of inputs, generating direct savings; applying them only where needed, improving soil quality and protecting areas that already have high soil quality; and applying them at the right time to maximize crop efficiency. This directly affects carbon sequestration through increased biomass accumulation and higher productivity.

Technologies such as satellite imagery, drones, and ground-based sensors, which generate Normalized Difference Vegetation Index (NDVI) maps and other vegetation indices, are highly promising for monitoring and quantifying carbon inputs in agricultural fields. In our research, we have made significant progress in developing algorithms that combine in-field sampling with image-based monitoring for commercial crops and cover crops, with high accuracy.

Another major potential of precision and digital agriculture for sustainable management is the development of Smart Rotation Plans (SRP). Based on a prior diagnosis of yield variability and its underlying causes, an SRP can be designed according to the specific potential of different cover crop species and/or plant families.

For example, in the most productive area, rotation plan A was adopted, maintaining an economically important crop such as wheat. In rotation plan B, the diagnosis identified insufficient soil cover and the presence of sheet erosion as the main problems; therefore, black oat was selected to rapidly increase soil cover. In rotation plan C, the diagnosis indicated soil compaction as the main factor limiting productivity; therefore, tillage radish was introduced as a biological strategy to help alleviate compaction.

In the medium term, this approach increased productivity and reduced variability in soil quality.

3) In your view, what are the main challenges for implementing regenerative practices at scale on farms in Brazil?

Without a doubt, the greatest challenge is the lack of management and planning in most farming operations — an issue that precision and digital agriculture techniques can help address. Even in well-structured and organized farms, it is often difficult to maintain a consistent crop rotation plan or a long-term investment strategy aimed at improving the chemical, physical, and biological attributes of the soil.

Another major challenge is the demand for immediate results. Farmers are often looking for management strategies that quickly meet their expectations, especially economic ones. However, regenerative practices require attention to detail, patience, and persistence, with a medium- to long-term perspective. This is not always something that farmers and technical advisors are willing to pursue consistently.

4) Could you share a recent result or success story that demonstrates the positive impact of using regenerative practices?

The first major result we obtained by combining precision agriculture techniques, crop rotation, and regenerative practices dates back to 2015. By simply changing the soil cover before soybean cultivation, we achieved yield gains of up to 20.3% after three years of adoption.

In the same study, changes in soil cover management also stimulated differences in the presence of earthworms (Oligochaeta) in the field, highlighting the potential to improve soil life after just one cycle of management change.

The study showed that, when the area remained under fallow for only three months, the earthworm population was reduced, with the lowest number of individuals. In contrast, systems with mixtures such as black oat + forage radish + vetch, black oat + forage radish, and black oat + vetch showed not only higher numbers of earthworms, but also greater uniformity in the distribution of these organisms. This demonstrates that species diversification and cover crop mixtures are effective pathways to improve soil biological life.

Another major benefit of regenerative practices is nutrient cycling and the possibility of reducing the use of external inputs, especially nitrogen.

In a study conducted in 2022 with three systems — forage radish, vetch, and white oat — we quantified nutrient cycling, particularly potassium and nitrogen, as well as the potential economic return if these nutrients had to be supplied through chemical fertilizers. Considering the average price of urea on March 31, 2022, at US$1,400.00 per ton, and the average price of KCl at US$1,226.90 per ton, the use of cover crops generated estimated savings ranging from US$546.84 to US$739.95 after converting the cycled nitrogen and potassium into equivalent amounts of urea and KCl.

It is important to emphasize that this represents a direct economic gain for farmers, but it also comes with broader qualitative improvements in soil health that should be taken into account.

5) What message or recommendation would you give to technicians, farmers, and young researchers interested in regenerative practices?

The message is that our generation has a moral responsibility to do something far greater than what our parents and grandparents did in favor of a more sustainable agriculture through regenerative practices. I have no doubt that the next major revolution in global agriculture will come from soil health.

Today, there are countless technologies available, both for investigating cause-and-effect relationships and for developing management solutions

Today, countless technologies are available for investigating cause-and-effect relationships, as well as for developing management solutions. This has significantly increased our capacity for diagnosis and improved the accuracy of decision-making.
In addition, Brazil plays a crucial role in global food production. Therefore, it is essential that technicians, researchers, and farmers join forces so that, with resilience, attention to detail, patience, and strong data intelligence, we increasingly adopt regenerative and sustainable practices — both to produce healthier food and to build a better planet.

Enhancing soil quality in the Brazilian semi-arid through integrated livestock - forest systems: a multivariate analysis approach

Crislany C. dos Santos, Rodrigo G. da Silva, Marcelo Cavalcante, Stoécio M.F. Maia

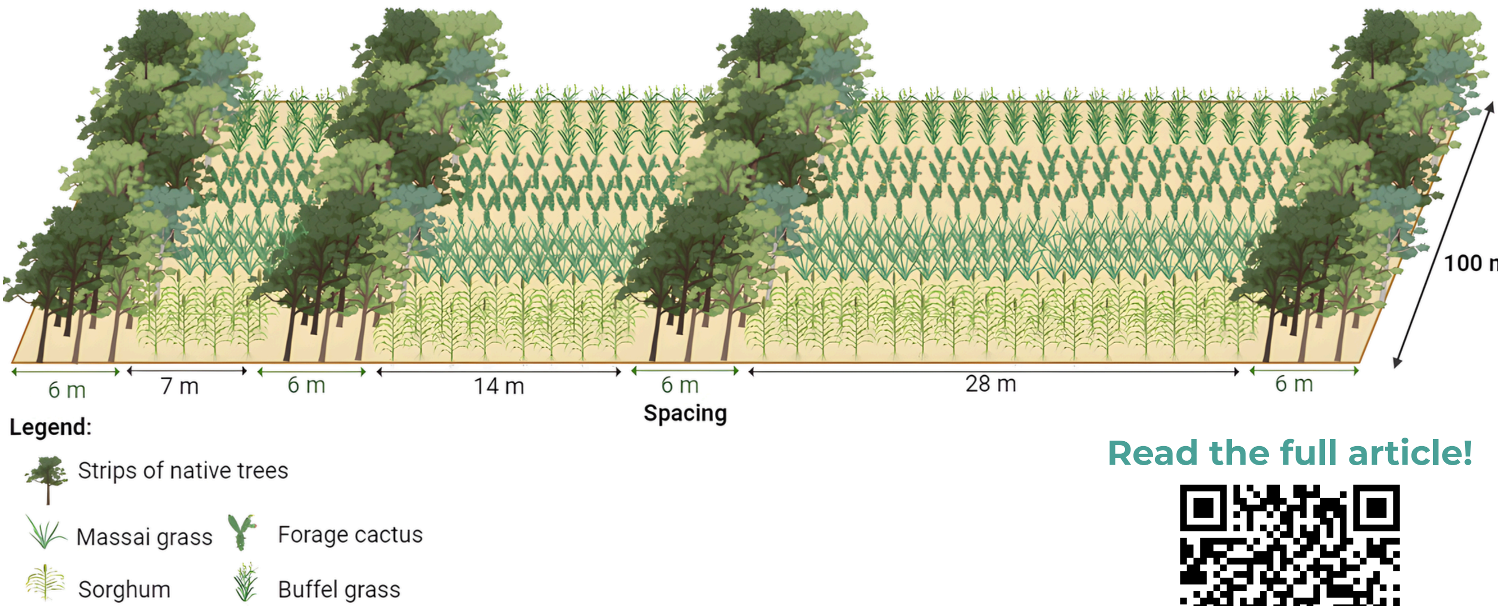
This study evaluated the performance of four integrated livestock–forestry systems (ILF) established six years ago in the Brazilian semi-arid region, with a focus on soil health. The systems analyzed included different forage crops: sorghum (So), cactus pear (Fc), massai grass (Mg), and buffel grass (Bg), arranged at spacings of 7, 14, and 28 meters between strips of native trees.

Eighteen physical, chemical, and biological soil indicators were considered, including organic carbon, mineral-associated organic matter, nitrogen, clay, phosphorus, and potassium. The Mg and Bg systems with 28-meter spacing stood out for showing the best results, with greater stability and average performance of these attributes, indicating higher sustainability and productive potential.

To classify and compare the systems, the Multi-Trait Stability Index (MTSI) was used — a tool originally applied in plant breeding and now adapted to assess the stability and performance of soil attributes in agricultural systems. Lower MTSI values in the Mg and Bg systems reinforce their superior performance in terms of soil health.

The experiment was conducted at the Federal Institute of Ceará – Limoeiro do Norte Campus, while the present research was carried out by the Federal Institute of Alagoas – Marechal Deodoro Campus and published in the journal Agroforestry Systems.

Stoécio Malta Ferreira Malta



Read the full article!

Cocoa Husk Treatment Project – Nestlé Cocoa Plan

The Nestlé Cocoa Plan is the first and largest sustainability program for cocoa production in Brazil, active in the country since 2010. Over 15 years, the program has grown significantly and now reaches more than 6,500 farms across the states of Bahia, Pará, Espírito Santo, São Paulo, Rondônia, and Tocantins.

The program focuses on promoting cocoa quality, encouraging good agricultural practices, and supporting the people and communities involved across the entire value chain. To achieve this, it invests in regenerative agriculture, technology adoption, and initiatives that increase productivity and the profitability of partner farms.

Among its regenerative agriculture initiatives is the Cocoa Husk Treatment Project. When cocoa pods are harvested, only 10–15% of the total fruit mass is used to produce cocoa beans. As a result, around 90% of the fruit consists of husks, which are usually left in the field, forming cocoa husk piles with no commercial value and with the potential to become a source of important fungal diseases, such as witches' broom (*Moniliophthora perniciosa*) and black pod rot (*Phytophthora* spp.).

Nestlé

Nestlé

For this reason, Nestlé, in partnership with ofi, developed the Cocoa Husk Treatment Project to train producers in the proper treatment of cocoa husks and their reuse as organic fertilizer.

The project trained producers from 116 farms participating in the Nestlé Cocoa Plan in the states of Bahia and Pará on the proper management of cocoa husk piles. Each farm received a technical visit, during which producers were trained on how to treat cocoa husks until they become a safe organic compost that can be returned to cocoa plantations.

Nestlé

The main objective of the project was to return the potassium present in cocoa husks to cocoa plantations in the form of organic fertilizer, while also controlling the spread of fungal diseases. In addition, treating cocoa husk piles helps reduce carbon emissions associated with waste management, compared with the common practice of leaving husks piled in the field to decompose slowly.

To expand the reach and impact of the project results, Nestlé made the Cocoa Husk Treatment methodology publicly available in the Integrated Pest and Disease Management Guide for Cocoa Production.

Access the guide here

Regenerative Agriculture Project in Cereals for "Mucilon" Infant Nutrition

With approximately 70% of its greenhouse gas emissions originating from agriculture and a commitment to achieving net-zero emissions by 2050, Nestlé launched, two years ago, a project to promote regenerative practices within the cereal supply chain for infant nutrition.

The project includes eight pilot farms in Brazil covering an area of 1,980 hectares, with three farms dedicated to corn production in Goiás and five focused on oat and wheat production in Paraná. Overall, Nestlé sources cereals from more than 100 farms across the country.

Nestlé

The selected farms receive specialized technical assistance to encourage the adoption of regenerative practices under the guidance of Agrobiota consultancy.

The promoted practices include:

- Crop rotation;
- Cover crops;
- Use of bioinputs;
- Integrated Pest and Disease Management (IPDM);
- Reduction of chemical inputs;
- Biological nitrogen fixation;
- No-tillage systems;
- Conservation and maintenance of crop residues;
- Tree planting.

The practice that generated the greatest impact was the use of cover crops, sown during the off-season or intercropped with the main crops. Adoption increased from 14% to 50% of the agricultural area within the participating farms.

These practices contributed to a reduction of more than 20% in the soil carbon footprint in 2024, according to measurements performed using the Cool Farm Tool.

The cereal line for infant nutrition uses 34.7 thousand tons of wheat, oat, corn, barley, and quinoa grains annually. The level of regenerative agriculture was assessed using the Farm Assessment Tool (FAT), reaching 100% regenerative supply in 2025.

Volume classification:

- Engaged: 21.7 thousand tons
- Advanced: 12 thousand tons
- Leader: 1.06 thousand tons

Challenge for 2026:

Expand regenerative practices to rice, which is also part of the cereal supply chain and represents 15.7 thousand tons.

Nestlé

Nestlé

Nestlé

Regenerative Agriculture Project in Cereals for PURINA

As part of Nestlé's commitment to source 50% of its key ingredients from regenerative agriculture practices by 2030, the company also supports the dissemination and adoption of these practices in grain and cereal production systems. These systems aim to produce while conserving and restoring natural resources, promoting healthier soils, reducing carbon footprints, and building greater resilience across agricultural production systems and value chains through a more holistic approach.

PURINA, Nestlé's pet food and nutrition division, has contributed to this journey by supporting several initiatives, including technical assistance for grain producers and incentives for research.

Through these initiatives, it has been possible to identify the early adoption of several regenerative agriculture practices. However, the holistic perspective of the production system has been the key factor driving the transition from conventional to regenerative agriculture.

Crop rotation and the use of cover crops have been essential, helping identify species best adapted to each production and management system while respecting planting windows. In addition, the history of regenerative agriculture adoption has benefited integrated crop–livestock systems and the production of organic compost, contributing to reductions in carbon footprints according to the productive reality of each participating farm.

Nestlé

News

Launch of the Book on Soil Health

On November 7, 2026, the book Soil Health in Tropical Ecosystems: The Foundation for Climate Change Mitigation and Adaptation was launched. This initiative was led by the Brazilian Soil Health Partnership and CCARBON/USP – Center for Carbon Research in Tropical Agriculture.
The book brings together contributions from 150 authors, 58 institutions, and 29 chapters, with all Brazilian regions represented. Special thanks go to the partners and supporters: FEALQ – "Luiz de Queiroz" Foundation for Agrarian Studies, FAPESP, and Nestlé.

Free e-book

News

XXXIX Brazilian Congress of Soil Science 2025

Part of the Brazilian Soil Health Partnership team attending the event.

News

Researcher Awarded by the Brazilian Society of Soil Science

The master's dissertation developed by Larissa Bortolo received the "Victor Hugo Alvarez V. Soil Science Award", granted by the Brazilian Society of Soil Science (SBCS), which recognizes the best theses and dissertations defended between 2023 and 2024.

The work was the winner in Division III – Soil Use and Management, among the five dissertations nominated in this edition.

The award ceremony took place during the Brazilian Congress of Soil Science, held in São Luís, Maranhão, and was represented by Prof. Maurício Roberto Cherubin, advisor of the work in the Graduate Program in Soils and Plant Nutrition at ESALQ/USP.

This recognition reinforces the relevance of the study and the joint effort of everyone involved, especially Prof. Maurício Roberto Cherubin, Rodrigo Munhoz de Almeida (Embrapa), and the Soil Health & Management Research Group (SOHMA).

News

Theodore M. Sperry Award 2025

From September 30 to October 4, the 11th World Conference on Ecological Restoration (SER2025) was held in Denver, organized by the Society for Ecological Restoration (SER). During the event, Prof. Pedro Henrique Brancalion, from the Department of Forest Sciences at the “Luiz de Queiroz” College of Agriculture (ESALQ/USP), became the first Brazilian to receive the Theodore M. Sperry Award.
The award recognizes individuals or organizations for significant and lasting contributions to advancing the science and practice of ecological restoration.

Leia mais:

Event

SOM 10th International Symposium on Soil Organic Matter

CCARBON CENTER FOR CARBON RESEARCH IN TROPICAL AGRICULTURE UNIVERSITY OF SÃO PAULO

2026 SÃO PAULO BRAZIL

📍 São Paulo, Brazil
📅 May 25–29, 2026
📌 International Dissemination Center of the University of São Paulo (CDI/USP) – São Paulo, Brazil

Learn more:

SOM

Events

Past Events

I Brazilian Regenerative Livestock Meeting

September 20, 2025 — Ribeirão das Neves, Minas Gerais, Brazil.

XXXIX Brazilian Congress of Soil Science – Soil Use under Climate Change

September 21–27, 2025 — São Luís, Maranhão, Brazil.

Upcoming Events

Oil & Gas Decarbonisation Congress 2026

February 9–10, 2026 — Vösendorf, Austria.

World Congress of Soil Science

June 7–12, 2026 — Nanjing, China.

20th National No-Tillage System Meeting

July 7–9, 2026 — Brasília, Brazil.

LIV Brazilian Congress of Agricultural Engineering

August 4–6, 2026 — Foz do Iguaçu, Paraná, Brazil.

Let’s think together?

How does soil health influence ecosystem restoration?

Find out in the next edition of Soil Health News.

Want to stay informed and learn more about soil health?

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