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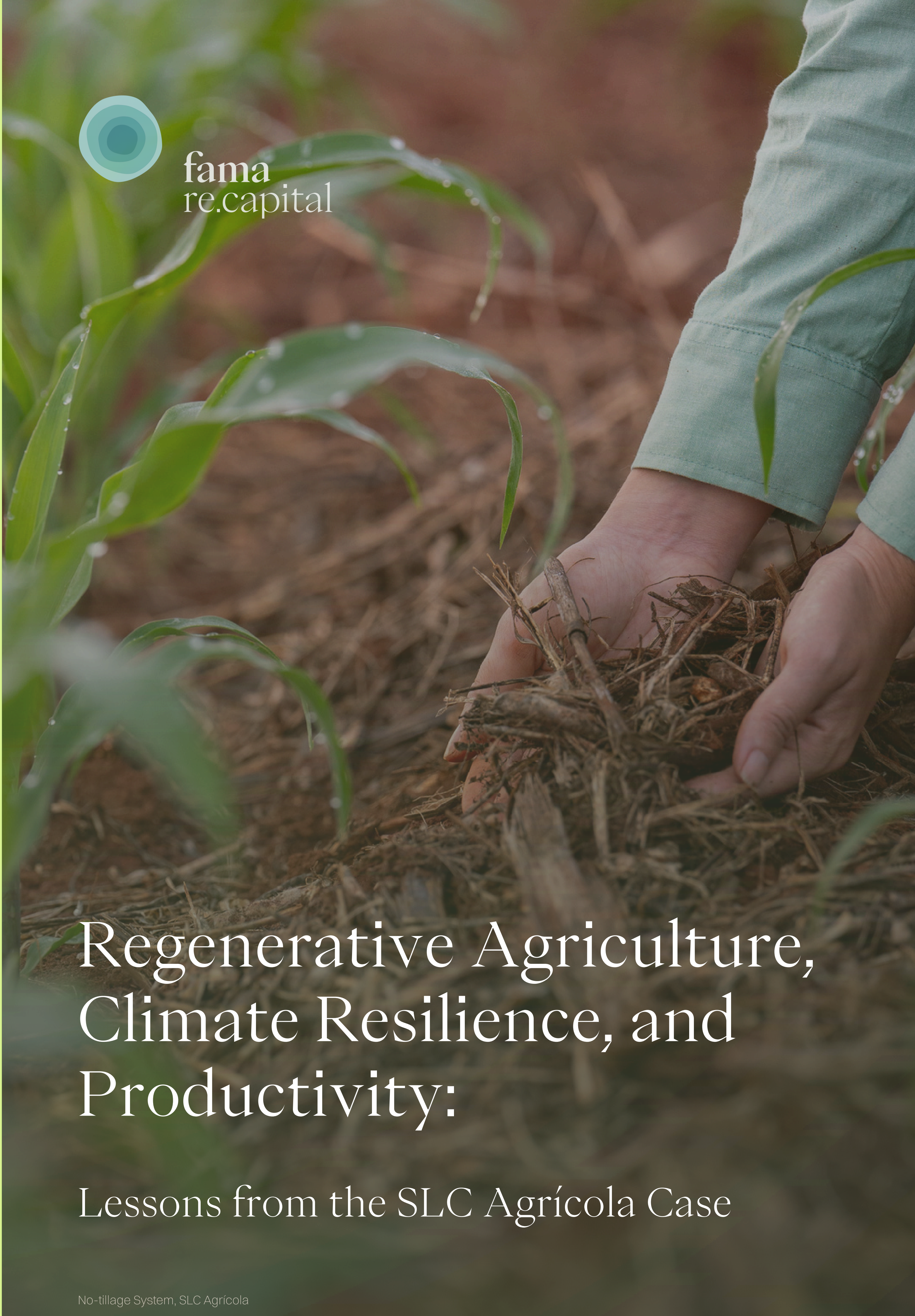

Regenerative Agriculture, Climate Resilience, and Productivity:

Lessons from the SLC Agrícola Case

No-tillage System, SLC Agrícola

Wheat Field Irrigation, SLC Agrícola

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SLC AGRÍCOLA

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1 Introduction

The exposure of Brazilian agribusiness to the impacts of climate change has become a systemic risk with direct implications for productivity, profitability, and business continuity. Episodes of prolonged drought, heatwaves, increasing frequency of irregular rainfall, and the intensification of phenomena such as El Niño[1] have undermined agricultural production in Brazil, leading to crop failures (Conab, 2022). **Estimates from Conab indicate that average soybean yields in Brazil fell by approximately 16% in the 2023/2024 harvest due to El Niño (Conab, 2025), with adverse effects on companies' operating results and market value.** For investors and financiers exposed to agricultural assets in the Cerrado and the Amazon, these events are not merely physical risks: they represent potential impacts on operational revenues, the timeframe of return on investments, and the valuation of agricultural assets, configuring a material climate risk that must be measured and priced.

In response to this growing vulnerability, regenerative agriculture practices are emerging as promising strategies to enhance the climate resilience of production systems. Unlike conventional agriculture, the regenerative approach prioritizes the restoration of soil ecological functions and the maximization of agroecosystem resilience. Practices such as no-tillage systems, continuous soil cover, use of bioinputs, diversified crop rotations, and crop-livestock integration systems have proven effective in improving soil health and stabilizing yields (Villat & Nicholas, 2024; Gosnell et al., 2020; Nwaogu et al., 2024; Souza et al., 2025). Studies demonstrate consistent improvements in soil physical structure and water-holding capacity, increases in soil organic carbon stocks, enhanced erosion control, and reduced yield variability under drought or excess rainfall conditions, in addition to co-benefits for biodiversity and ecosystem services (Barbieri et al., 2024; Nwaogu et al., 2024).

[1] Warm phase of the ENSO phenomenon, in which Equatorial Pacific waters become warmer than average, altering rainfall and temperature patterns globally; in Brazil, it usually brings more rain to the South and drought/heat to the Center-West/North, affecting crops.

The case of SLC Agrícola illustrates this convergence between productivity and climate resilience. The company cultivated 735,000 hectares with at least one regenerative practice across each farmland parcel in the 2024/2025 season and, in recent years, has consistently reported soybean and cotton yields above national averages. The company systematically assesses risks associated with shifts in rainfall patterns and the intensification of extreme weather events and has identified the value of resilient agriculture through regenerative management. These strategies include agronomic measures such as crop rotation, no-tillage systems, selective adoption of cover crops, optimization of crop protection via variable-rate application (typically relying on Geographic Information Systems) and expanded use of bioinputs. Furthermore, the company has cumulative information over 18 years of implementing regenerative practices, enabling it to quantify their role in mitigating climate impacts on agricultural production.

Nevertheless, recognition of such practices as competitive advantages still faces significant barriers. Financial markets do not yet adequately account for climate-related financial risks and therefore fail to measure or reward the climate resilience of agricultural assets. In addition, there are no standardized and comparable indicators to assess the effectiveness of climate strategies implemented by agricultural companies. Without clear adaptation metrics[2] , climate risk remains mispriced and difficult to incorporate into credit risk models, asset valuation, or eligibility criteria for sustainable finance instruments. Likewise, public policies such as the *Plano Safra* (Brazil's annual agricultural policy, including credit and economic subsidies) and financial system regulations still lack objective criteria that recognize and reward ecological regeneration in agricultural production. Building robust empirical evidence that links regenerative practices to climate resilience and value creation is thus crucial to unlocking capital flows toward resilient, low-carbon agriculture.

This document seeks to contribute to the debate on regenerative agriculture and climate resilience in Brazil by examining the connections between regenerative practices and productivity through the experience of SLC Agrícola, drawing on public data and available scientific literature. Finally, we aim to outline recommendations on how to foster an enabling environment for recognizing climate resilience as an asset in agribusiness, capable of attracting investment and financial incentives.


Cotton Field, SLC Agrícola

[2] In human systems, "the process of adjusting to actual or expected climate and its effects, in order to moderate harm or take advantage of opportunities"; in natural systems, "the process of adjusting to actual climate and its effects"; human intervention may facilitate adjustment.

2 How Regenerative Agriculture Practices Can Promote Climate Resilience and Productivity in Agribusiness

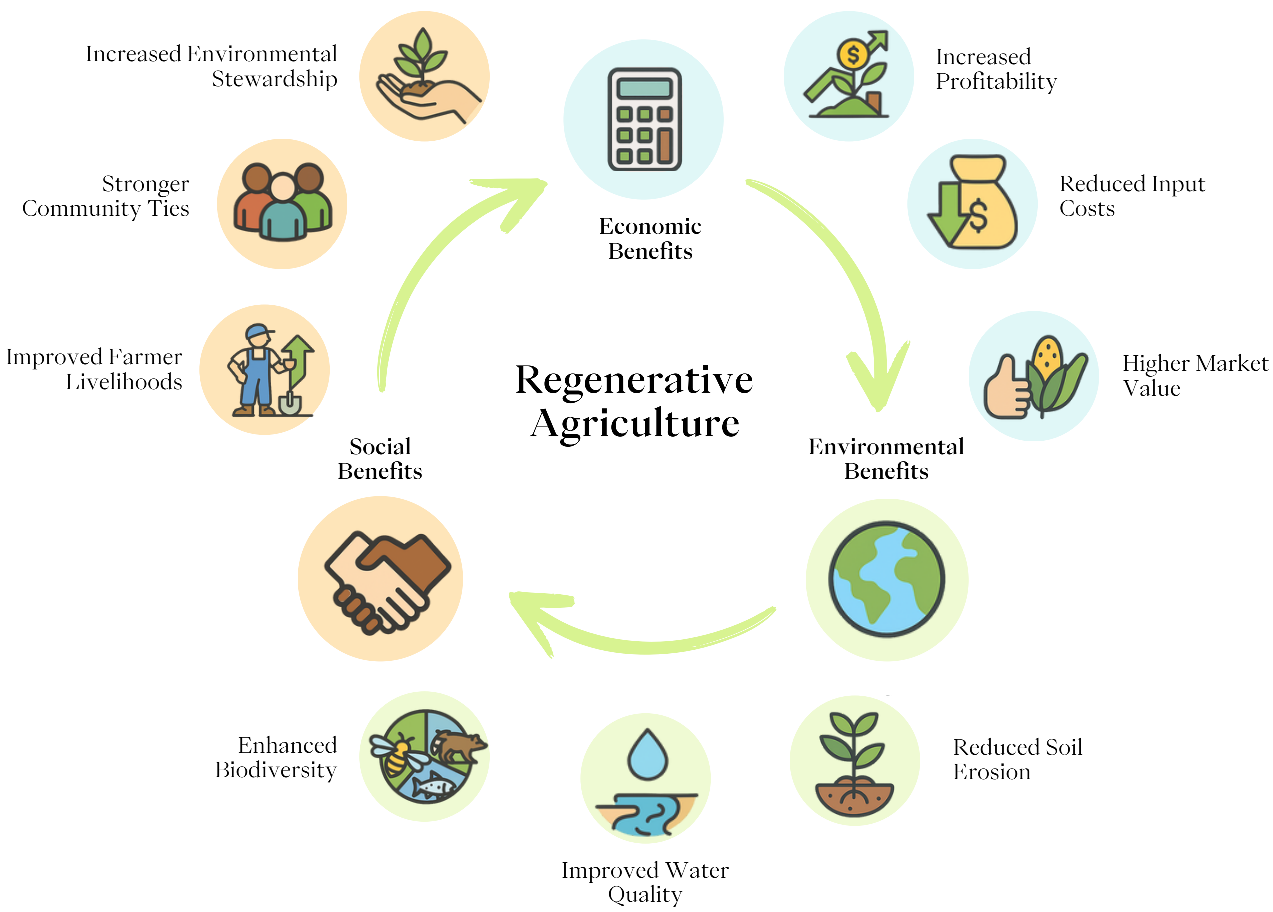
Regenerative agriculture is a consolidated production approach that restores soil functions and strengthens resilience in the face of growing climate instability, while replicating key natural processes to sustain productivity. Its distinguishing feature lies in promoting soil health as the structural axis of agricultural production, unlike conventional approaches that treat soil merely as a physical substrate. In practice, such interventions can reduce erosion losses, increase water infiltration and retention, and promote the accumulation and stabilization of soil organic carbon, with implications for climate change mitigation. For example, sustainable soil management through no-tillage systems and the use of bioinputs can reduce temperature fluctuations in the arable layer, increase biological diversity and cycling processes (nutrients, water, oxygen), promote more efficient remediation processes, and stabilize crop yields in years with adverse climatic impacts. In tropical soils such as those of the Cerrado and the Amazon, which are often low in organic matter and highly vulnerable to erosion, this approach represents a strategic gain for farmers.

Recent scientific evidence indicates that regenerative practices such as no-tillage systems, continuous soil cover, diversified crop rotations, bioinputs, and crop-livestock integration systems increase the soil's capacity to store water, sequester carbon, and maintain productivity under extreme weather events (Villat & Nicholas, 2024; Gosnell et al., 2020). Farm-level studies show that regenerative systems present higher levels of organic matter and improved soil health[3] compared to conventional systems (Montgomery et al., 2022; Bünemann et al., 2018). For instance, there is evidence that replacing conventional tillage with no-tillage systems combined with cover crops and diversified rotations can increase soil organic carbon stocks in certain soil types by up to 0.8 t/ha/year in the Cerrado (Corbeels et al., 2016). This robust ecological foundation translates into reduced yield variability, improved nutrient-use efficiency, and lower dependence on synthetic inputs. Other studies report similar magnitudes of carbon sequestration (Maia et al., 2022; Oliveira et al., 2022).

[3] The soil health indicators listed by Bunemann et al. (2018) assess physical, chemical, and biological attributes in combination, providing a holistic comparison of the substrate.

In the Brazilian context, practices such as crop-livestock integration systems and the strategic use of cover crops are particularly relevant, since intensive farming systems in tropical regions with concentrated rainfall increase the risk of physical and biological soil degradation. For this reason, these practices are already being adopted by corporate farming groups and producers in the Cerrado, with the support of the *Brazilian Agricultural Research Corporation* (EMBRAPA, in Portuguese acronym) and credit lines under the *RenovAgro* Program (formerly the ABC Program, as Brazil's main public rural credit policy for low-carbon agriculture)[4].

The adoption of regenerative practices provides not only a technical response, with improvements in crop agronomic performance, but also an economic opportunity: by reducing dependence on synthetic inputs and buffering losses in critical years, these practices can contribute to greater stability in farm revenues. A recent 16-year study conducted in Mato Grosso (Nwaogu et al., 2024) demonstrated that the adoption of diversified crop rotations increased biological productivity while reducing interannual variability. In practice, more diversified rotations and continuous soil cover reduce yield variability and enhance predictability for farmers and value chains.



[4] Policy of the Ministry of Agriculture (MAPA) that guides low-emission and adaptation practices in agriculture and livestock (e.g., crop-livestock integration, soil carbon sequestration, water management), including credit instruments and MRV mechanisms aligned with the climate agenda.

However, despite advances, the adoption of regenerative agriculture faces obstacles: there are gaps in technical knowledge, logistical challenges (particularly for organic fertilization), and a lack of clear economic incentives (e.g. premium prices) for the ecological benefits generated (McCarthy & Rushforth, 2025). Furthermore, many resilience gains are cumulative and materialize in the mid to long-term (e.g., improvements in soil organic matter and structure), which may generate skepticism when there is no immediate correlation with yield in a single cycle. These factors explain the variation in results observed in both scientific studies and field practice. Understanding the actual effects of each practice, as well as their benefits and limitations, is essential to guide policy design and investment decisions.

Below, we present a summary table of the main regenerative practices, their benefits for climate resilience, and their implementation challenges, based on recent empirical evidence.

Table 1.

Regenerative practices, climate benefits, and implementation challenges.

Regenerative Practice	Benefits for Climate Resilience	Implementation Challenges
No-tillage systems	Increases soil carbon, reduces erosion, improves water infiltration; lowers diesel consumption associated with tillage operations.	Incomplete adoption of all pillars limits the full expression of benefits; shallow soil correction; risk of compaction; requires appropriate machinery.
Cover crops	Nutrient cycling and "green manure" effect; diversification of vegetation and soil biological community; erosion control through surface cover; increased and improved quality of soil carbon; reduced soil temperature variability. Root growth also helps soil decompaction.	When intercropped with cash crops such as maize, may compete for water in dry climates and reduce yields. Requires management similar to cash crops (weed and pest control, etc.).
Diversified crop rotations	Yield stability (interannual resilience); pest reduction; contributes to enhanced soil biodiversity; foundational pillar of no-tillage systems.	Requires rotational planning and logistical coordination (e.g., availability of suitable machinery locally); subject to fluctuations in crop market prices.

Regenerative Practice	Benefits for Climate Resilience	Implementation Challenges
Organic fertilization	Gains in carbon and fertility; improves soil structure; enhances fertility and water retention.	Input costs; logistical complexity of application; longer time for return; requires cultural adaptation.
Biological management (bioinputs/ biological crop protection)*	Reduces use of synthetic molecules; increases populations of beneficial microorganisms; improves soil biodiversity; beneficial effects on plant growth; contributes to crop climate adaptation.	Requires technical support; cost; transition period.
Crop-livestock integration systems	Diversifies production; increases carbon sequestration; improves land-use efficiency, ecological stability, and climate resilience. A forestry component can be added.	Requires infrastructure and knowledge of integrated management; risk of over- or under-grazing.
Agroforestry systems	Carbon sequestration; microclimate regulation; water conservation.	Long return period; scalability limitations.

**Conventional chemical "crop protection products" are not considered regenerative practices in this report. Biological crop protection products (microbial or biochemical) and inoculants are included under "Biological management.".*

The main conclusion of scientific studies is that there is no single solution to adapt and mitigate the effects of extreme climate events on agriculture: the greatest resilience gains occur when practices are combined and tailored to the local context. For example, the joint adoption of no-tillage systems with crop rotations and cover crops increased productivity and financial stability in regenerative maize and soybean systems in the United States, without penalizing yields even in years of severe drought (Montgomery et al., 2022). In parallel, in Brazil, some analyses show that crop-livestock integration systems combined with crop rotations are among the strategies with greatest traction among medium and large-scale producers, with synergistic effects on soil quality, productivity, and climate risk reduction.

Data also shows that the economic benefits of regenerative agriculture can manifest in different dimensions: stabilization of operating margins, reduction of fertilizer and crop protection costs, lower exposure to extreme losses, and, in the future, eligibility for carbon markets and agri-food supply chains with increasing environmental requirements. However, variability in outcomes and the absence of standardized metrics still make it difficult to fully recognize these gains financially.

Crop-Livestock Integration, SLC Agrícola

2.1. Environmental and Economic Benefits

2.1.1. Climate Mitigation and Adaptation

It is important to distinguish between the adaptation and mitigation benefits provided by regenerative practices. In the climate context, adaptation refers to adjustments in human and production systems in response to the adverse effects of climate change, as defined by the Intergovernmental Panel on Climate Change (IPCC), and not to the physiological mechanisms of organisms (commonly referred to as "acclimation"). Mitigation, in turn, refers to the prevention, reduction, or removal of greenhouse gas emissions from the atmosphere, thereby avoiding the aggravation of global warming. For example, the use of cover crops reduces surface runoff, preserves surface organic matter, and enhances crop resilience (adaptation); while at the same time contributing to soil carbon accumulation and reducing the demand for synthetic fertilizers (mitigation).

Overall, regenerative practices have strong potential for climate mitigation, particularly through stabilization of carbon in soil organic matter, reduction of agricultural operations, increased input-use efficiency, and substitution of inputs with high carbon footprints. Increasing organic matter within the top 30 cm of soil allows for significant carbon sequestration, depending on the system adopted, natural conditions, and soil characteristics. For instance, in SLC Agrícola's areas, carbon sequestration can reach 0.6 t/ha/year (Bayer et al., 2006a), while estimates for the Cerrado biome are even higher (Corbeels et al., 2016).

Systems that combine crop rotations, crop-livestock integration, and continuous soil cover can also significantly reduce greenhouse gas emissions, particularly nitrous oxide (N2O), by improving efficiency and lowering nitrogen fertilizer applications. This capacity to act as a carbon sink positions regenerative agriculture as a bridge between agricultural production and climate neutrality, reinforcing the role of the sector in meeting the mitigation targets established under the UN Paris Agreement. The following table summarizes the benefits of each practice for mitigation and adaptation.

Table 2. Examples of agricultural practices with cross-cutting adaptation and mitigation benefits

Regenerative Practice	Adaptation Benefits	Mitigation Benefits
No-tillage systems	Greater water retention, reduced erosion, improved soil health, and lower yield variability. Creates a more resilient environment.	Soil carbon accumulation; reduced emissions from mechanization.
Cover crops	Soil thermal regulation; reduced evaporation; root growth contributes to soil decompaction.	Increased biomass and carbon stocks in the system. More balanced systems, with diversified and constant residue input, show higher nutrient-use efficiency.
Diversified crop rotations	Breaks pest and disease cycles; interannual yield stability.	Diversified residues enhance carbon stabilization. More balanced systems, with diversified and constant residue input, show higher nutrient-use efficiency.
Organic fertilization	Improves soil quality, increasing tolerance to adverse drought effects and enhancing water retention.	Substitutes synthetic fertilizers (reduces production demand); contributes to carbon sequestration.
Agroforestry systems	More stable local microclimate and increased soil water retention; reduced erosion; improved soil quality; greater ecological resilience.	Increased carbon sequestration rates through trees and soils; biodiversity conservation.

2.1.2. Operational and Financial Gains

In addition to biophysical gains, regenerative agriculture generates measurable operational and financial impacts, with direct implications for risk reduction and return enhancement in agricultural assets. Integrated systems of no-tillage, crop rotations, and continuous soil cover reduce interannual yield variability by up to 40% compared to conventional systems (Ray et al., 2015; Montgomery et al., 2022; Nwaogu et al., 2024). In tropical regions with high rainfall variability, this stability can preserve significant gross revenue in dry years by reducing losses without major additional investment requirements. It is also common for producers to overinvest in unnecessary measures when attempting to respond to crisis situations.

Precision Agriculture, SLC Agrícola

From a cost perspective, biological nitrogen fixation in soybeans can replace a large share of mineral nitrogen fertilization (Hungria et al., 2010). Similarly, the use of plant growth-promoting microorganisms and covering crops helps reduce dependence on synthetic fertilizers. Moreover, diversified systems with biological management can significantly decrease the need for pesticides (Pretty et al., 2018), translating into immediate margin gains. Additionally, soils managed under conservation practices retain volumes of water that prevent severe yield losses during hydric deficits (Basche & DeLonge, 2017; Lal, 2020), strengthening cash-flow predictability and asset attractiveness in the market. In particular, in rainfed systems, conservation soil management (e.g., no-tillage and soil cover) can prevent yield reductions of up to 12% in years of moderate water deficit (Lal, 2020).

3 Case Study: How SLC Agrícola's Production Strategy Generates Climate Resilience

SLC AGRÍCOLA

With over 18 years of soil data and fully digitalized farm management, SLC Agrícola has directly observed the growing exposure of its farms to climate risks. In 2021 and 2022, the company adopted public commitments to become deforestation and conversion-free (DCF) and to achieve carbon neutrality in Scope 1 and 2 emissions by 2030. These commitments marked the beginning of a systematic integration of climate risks into its business strategy.

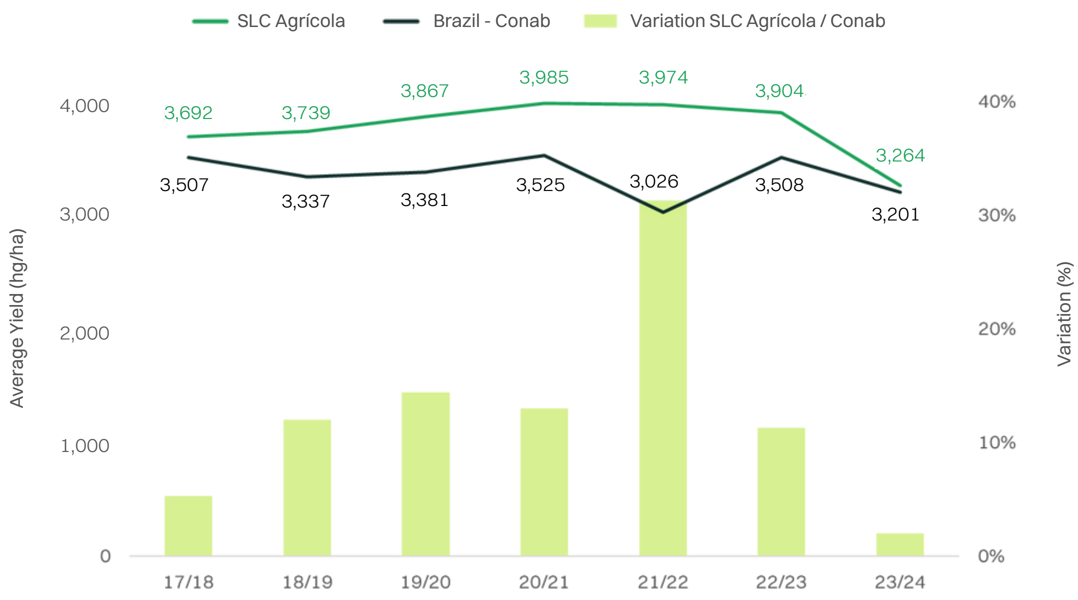
SLC Agrícola represents one of the leading Brazilian cases of transition from industrial agriculture toward production systems guided by sustainability and regenerative practices. With approximately 830,000 hectares of planted area projected under management for the 2025/2026 crop season, the company operates at large industrial scale while demonstrating increasing alignment with principles of regenerative agriculture. Practices such as no-tillage systems, crop rotations, bioinputs, continuous soil cover, and the integration of climate data into farm planning have been gradually incorporated over the past decades, with greater intensity in units certified under programs such as the *Regenagri program*. Today, nearly 100% of the company's cultivated area applies at least one regenerative practice.

This agronomic transition process has been accompanied by measurable productivity gains. Between the 2017/2018 and 2023/2024 seasons, SLC Agrícola's average soybean yields consistently outperformed the national average reported by *Conab*, with an average difference of 12% (Fig. 1). In the 2021/2022 crop year, for example, the company's productivity was about 31% higher than the national average.

On SLC Agrícola's top-performing farms, average soybean yields can reach more than 90 sacks/ha (5,803 kg/ha) (Fig. 2). Across its portfolio, the company maintained relatively stable productivity between the 2020/2021 and 2024/2025 seasons, averaging 66 sacks/ha in the most recent year across 377,500 hectares[5] of soybean cultivation. Such low yield volatility is a strong indicator of climate resilience, particularly in a predominantly rainfed context exposed to pests, droughts, and intensive rainy periods ("*invernadas*"). For maize, a crop more sensitive to climatic variability, average yields increased from 2020 to 2025, reaching 132 sacks/ha in the most recent year, partly due to the expansion of irrigated areas. Although more volatile than soybean, maize performance also suggests efficient adaptive mechanisms.

These gains derive not only from operational scale, geographic diversification, or input intensity, but also from the cumulative effect of agronomic improvements and management in extensive cultivated areas. For example, soybean-maize-cotton rotation systems have contributed to greater yield stability and more efficient nutrient cycling. The aggregated effects of regenerative practices can thus be observed in SLC Agrícola's results, which demonstrate the stability of large-scale agricultural production.

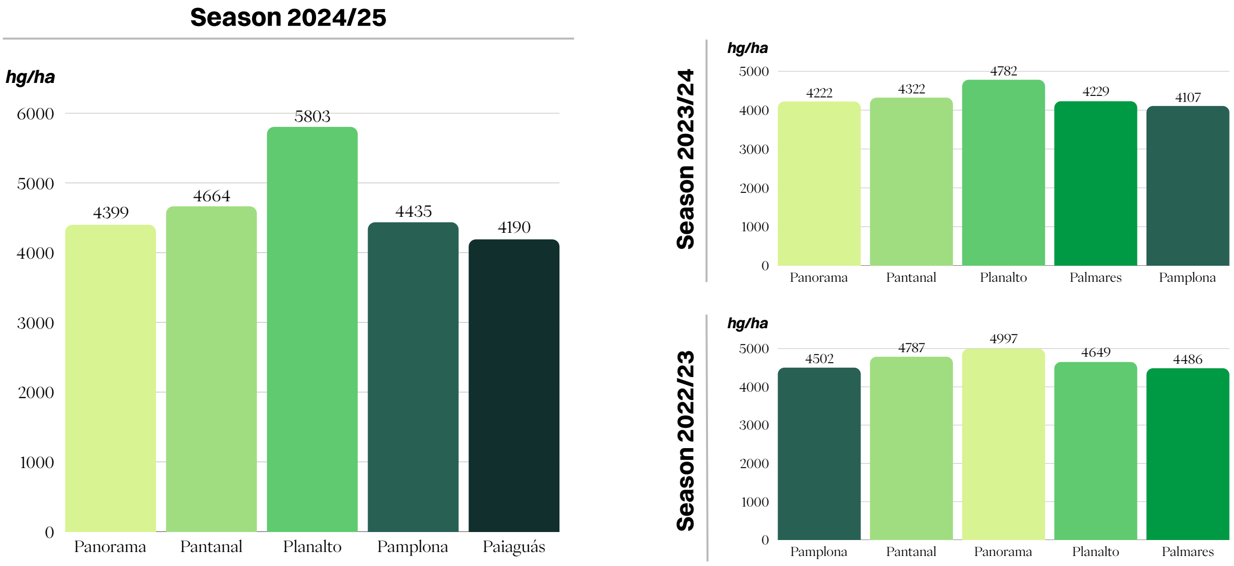
Figure 1. Comparison of SLC Agrícola's average yield and the national average in Brazil according to Conab.



Source: SLC Integrated Reports, SLC Farm Day Presentation "Status of the 2024/25 Crop and Why Irrigate" (2025), and Conab data.

[5] See Farm Day SLC Presentation "24/25 Crop Status and Why Irrigate," at: https://api.mziq.com/mzfilemanager/v2/d/a975c39b-3eca-4ad8-9330-2c0a0b8d1060/a27d4588-1313-1b59-7235-aebe2146f1b6?origin=1

Figure 2. SLC Agrícola farms with the highest soybean yields.



Source: Adapted from SLC Farm Day Presentation "Status of the 2024/25 Crop and Why Irrigate" (2025).

SLC Agrícola's productive performance can be attributed to the set of practices adopted across its operations. No-tillage systems are applied in approximately 100% of the cultivated areas and in all company units. Soil cover between crop cycles is partially implemented, present in 35.6% of the total commercial crop area. The use of bioinputs accounts for 16.7% of all crop protection applications, while inoculants are applied in 100% of farms. Crop rotations, including second-harvest maize ("*safrinha*", in Portuguese) and cotton, are consolidated across SLC Agrícola's farms. In addition, the company has 4,473 hectares under crop-livestock integration systems, which introduce an additional productive activity to the two annual harvests and increase land productivity where implemented.

SLC Agrícola's regenerative agriculture strategy is centered on soil as a strategic asset to sustain large-scale productivity and mitigate climate vulnerabilities[6]. The use of grain-forage intercropping systems, such as the *Santa Fé System* (maize + *Brachiaria* forage grass), expands soil use capacity through root depth, enhances interactions with soil microbiota, lowers surface temperature, and promotes straw accumulation. This results in improved water retention and yields stability. Crop and cover diversification has advanced, with biomass production reaching up to 20 t/ha (*Brachiaria*) and potential fertilizer savings of R$600–1,200/ha through nutrient cycling (20% N, 30% P_2O_5, and 50% K_2O released to subsequent crops)[7].

Currently, more than 90% of cultivated areas adopt conservation practices such as no-tillage systems, deep liming, and anti-erosion management. Since 2019, soil biological indicators (e.g., *arylsulfatase and β-glucosidase*) have been monitored in 50% of rainfed areas and 100% of irrigated areas, showing a positive correlation with soybean and cotton yields. In 2024, these

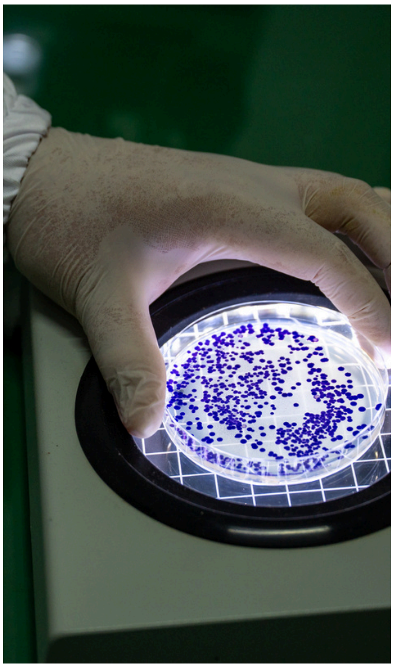
[6] See Farm Day SLC Presentation "Regenerative Agriculture: Healthy Soils to Grow Resilient Businesses" (2025), at https://api.mziq.com/mzfilemanager/v2/d/a975c39b-3eca-4ad8-9330-2c0a0b8d1060/69f3551c-ab46-a18e-8289-6b259f1faab0?origin=1

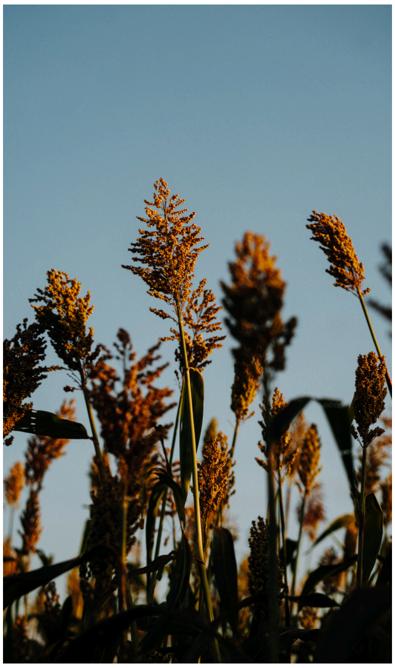
[7] (Ibid).

practices resulted in the net removal of 552,000 tCO_2e, offsetting 54% of Scope 1 emissions, while simultaneously reducing costs, improving return predictability, and strengthening eligibility for environmental certifications. By transforming healthy soils into a competitive advantage, SLC Agrícola combines agronomic efficiency, climate resilience, and land asset valuation in a single operational strategy. Indeed, the adoption of practices such as no-tillage reduces annual Soil Organic Carbon (SOC) loss rates compared to conventional tillage, as evidenced by Bayer et al. (2006b). It also has the potential to increase carbon sequestration rates by 0.6 t/ha/year in SLC Agrícola's areas, as shown in studies specifically conducted on the company's farms (Bayer et al., 2006a; Locatelli et al., 2025). Recent studies indicate that such carbon accumulation is associated with improvements in water-holding capacity, soil structure stability, and reduced need for supplemental irrigation; which are central factors for climate adaptation in tropical regions.

In summary, the main adaptation measures reported[8] by the company are crop rotations (soybean-maize-wheat/cotton) and the maintenance of crop residues (straw mulch) on the soil surface as a strategy against water stress. The crop residues left after harvest derives mainly from second-season maize and cover crops, which are essential to lowering soil temperature and retaining moisture in rainfed systems[9]. In the absence of irrigation, these practices play a critical role in maintaining yields. The company reports[10] that the combined use of no-tillage systems, continuous soil cover, and systematic application of bioinputs has favored water retention, soil health, and crop responsiveness to hydric and thermal stress. These are core features of climate-resilient agriculture as continuous soil cover directly contributes to organic matter accumulation and thermal balance in the topsoil, reinforcing climate adaptation in rainfed systems.


No-tillage Systems, SLC Agrícola


Biofactory, SLC Agrícola


Cover Crops, SLC Agrícola

[8] See the SLC 2024 Integrated Report: https://www.slcagricola.com.br/wp-content/uploads/2025/03/Relatorio-Integrado-2024.pdf

[9] See SLC's presentation on healthy soils: https://api.mziq.com/mzfilemanager/v2/d/a975c39b-3eca-4ad8-9330-2c0a0b8d1060/69f3551c-ab46-a18e-8289-6b259f1faab0?origin=1

[10] (Ibid).

Figure 3. Practices adopted by SLC Agrícola and expected impacts.

Adopted Practice	Expected Effects
No-tillage systems	Maintenance of soil carbon stocks; greater soil water retention; lower crop yield variability; reduced erosion rates; decreased operational costs and diesel consumption.
Soybean-maize-cotton rotation	Greater crop diversification and varied residue input (pillar of no-tillage systems); reduced pesticide uses and higher efficiency in the use of pesticides and fertilizers.
Inoculants for biological nitrogen fixation and growth promoters	Increased efficiency in nutrient and water use; reduced nitrogen fertilizer demand.
Bioinputs (biopesticides)	Reduced conventional chemical pesticide use and toxicity.
Cover crops between seasons	Green cover over soil maintains biological activity; nutrient cycling (improved use efficiency); enhanced soil quality.

3.1. Irrigation as a Climate Adaptation Strategy

Irrigation is a central theme in the context of agricultural adaptation to climate change, as it reduces water-related volatility and stabilizes productivity. Although SLC Agrícola's operations are predominantly rainfed, the company has selectively expanded irrigation in regions with greater climatic variability, such as the western region in the State of Bahia. Currently, 24,939 hectares are irrigated[11], i.e. 3.3% of the planted area. The goal is to reduce climate risk and expand the time windows for planting and harvesting.

[11] See Material Fact "Projections for the 2024/25 Crop and Irrigation Project," referring to data from the second quarter of 2025, released on July 9, 2025, at: https://api.mziq.com/mzfilemanager/v2/d/a975c39b-3eca-4ad8-9330-2c0a0b8d1060/be7e71bc-da12-a4ba-1c5d-be08a34d2004?origin=1

SLC Agrícola's irrigation strategy has been structured as a driver of productivity expansion, stability, and land appreciation, anchored primarily in the use of center pivots[12]. At present, the company operates 23 pivots covering 3,980 hectares across five farms (named *Pamplona, Piratini, Paysandu, Palmares, and Paladino*), with another 19 pivots under construction that will add 2,970 hectares. Looking ahead, there are plans for 38 additional pivots, representing another 5,995 hectares. This would expand the total irrigated area from 16,025 hectares in 2024/2025 to 19,385 hectares in 2025/2026, and ultimately to 53,180 hectares at full implementation. This pace of expansion mirrors a national trend, as irrigated cropland in Brazil has grown by an average of 370,000 hectares per year (around 4.5% annually over the last decade), with center pivots already accounting for 52% of the irrigated area.

The economic rationale is explicit: irrigation not only boosts yields and allows for increased sowing areas but also raises land value beyond the level of investment, ensures productive stability in adverse climatic years, enables value addition through seed production and crop diversification, and consistently increases per-hectare profitability. These operational gains align directly with the regenerative agriculture agenda, reinforcing irrigation as a lever for both economic performance and climate resilience within the company's business model.

The SLC Agrícola communication for the 2024/2025 harvest season clearly illustrates the technical impact of irrigation. For soybeans, irrigated areas have reached around 5,800 kg/ha, while rainfed yields across the company's farms have averaged between 4,100 and 4,600 kg/ha in recent years, meaning a yield increase of 20–30%. The company reported that, in one soybean farm, irrigated plots yielded 74 sacks per hectare, compared to 35 sacks in rainfed plots. The case of the Paysandu farm in 2024/2025 also illustrates this difference: projected irrigated soybean yields were 120 sacks/ha (7,200 kg/ha, considering 60 kg per sacks) compared to approximately 104 sacks/ha under rainfed conditions, a gain of nearly 15%. In first-crop cotton, the difference is equally striking, with irrigated yields estimated at up to 360 arrobas/ha, versus 300–310 arrobas/ha in non-irrigated plots.

Wheat Field Irrigation, SLC Agrícola

[12] See Farm Day SLC Presentation "2024/25 Crop Status and Why Irrigate," at: https://api.mziq.com/mzfilemanager/v2/d/a975c39b-3eca-4ad8-9330-2c0a0b8d1060/a27d4588-1313-1b59-7235-aebe2146f1b6?origin=1

3.2. Corporate Strategies to Create Value from Climate Resilience

Of the company's 23 farms, six have been certified under the Regenagri program, which promotes regenerative practices that increase soil organic matter, foster biodiversity, sequester carbon, and improve water and energy management. Certification requires continuous commitment and the submission of improvement plans for already certified farms. According to the company's 2024 Integrated Report[13], the goal is to certify 485,000 hectares by 2029.

The company is also exploring pathways to achieve partial "carbon neutrality" through ongoing pilot projects for soil carbon measurement. Consolidating these data, together with advances in measurement, reporting, and verification (MRV) methodologies, would enable SLC Agrícola to monetize these ecosystem services through payments for environmental services, voluntary carbon markets, or emerging domestic carbon pricing schemes. However, regulatory and methodological challenges remain, such as the high cost of sampling (since deeper soil layers must also be analyzed), difficulties in establishing baselines, and variability across microregions.

In parallel with agronomic practices, SLC Agrícola adopted a deforestation and conversion-free (DCF) land-use policy in 2021. This decision shifted company growth toward sustainable intensification, reinforcing the role of regenerative agriculture as a pathway for productivity gains and climate resilience. At the same time, this commitment reduces the risks of GHG emissions from land-use change and grants access to international markets that require deforestation-free supply chains. Yet, as with adaptation metrics, the economic benefits of this land-use policy are still underrecognized in credit and valuation models, representing an opportunity for financial instruments that internalize the value of native ecosystem protection.

By integrating these practices into a digital farm management system, SLC Agrícola not only optimizes operational decisions in real time but also builds a data repository that can serve as a strategic asset in negotiations with financiers, buyers, and certification bodies. This evidence base enables the company to quantify the economic benefits of resilience and translate them into tangible arguments for raising capital and improving risk perception in the market. The irrigation strategy, for example, is guided by an economic rationale of land appreciation and higher profitability per hectare, while also acting as a risk mitigation mechanism by reducing rainfall-related volatility and ensuring supply consistency for high-demand, high-value crops.

[13] See SLC 2024 Integrated Report, at: https://www.slcagricola.com.br/wp-content/uploads/2025/03/Relatorio-Integrado-2024.pdf

4 Indicators and Metrics of Climate Adaptation in the Agricultural Sector

Measuring climate adaptation in agriculture requires clear, comparable metrics aligned with internationally recognized frameworks. At the same time, adaptation indicators in agriculture must be simple to understand and consistent over time. In this context, the United Nations (UN) has established principles for agriculture aligned with the Sustainable Development Goals (SDGs), particularly those focused on food security, soil health, biodiversity protection, and climate change mitigation. In parallel, the United Nations Framework Convention on Climate Change (UNFCCC) has advanced the definition of common metrics for agricultural climate resilience, focusing on yield stability, reduction of losses from extreme events, and water-use efficiency[14]. Furthermore, the UNFCCC is developing indicators to measure progress toward a Global Goal on Adaptation, which is expected to include climate resilience metrics specifically for the agricultural sector to be adopted at the 30th Conference of the Parties (COP30), to be held in Belém, Brazil, in November 2025. At the time of drafting this report, a preliminary list of indicators under discussion had already been produced[15].

Integrating these international references into the Brazilian reality is fundamental to ensuring both global comparability and local relevance. This means combining indicators of land use and adaptive management (e.g., proportion of area under regenerative practices, crop rotation, integrated pest management) with metrics of performance under climate shocks (e.g., yield stability, variation in net income) and adaptive infrastructure (e.g., irrigation, climate risk mitigation). This approach allows governments, financiers, and producers not only to monitor resilience but also to use it as a criterion for rural credit, agricultural insurance, green taxonomies, and market instruments.

[14] See SLC 2024 Integrated Report, at: https://unstats.un.org/sdgs/metadata

[15] The document can be accessed at: https://unfccc.int/documents/645725

Below, we present a suggestion for building climate resilience indicators in agriculture for the Brazilian context, based on UN/UNFCCC frameworks and the practices of SLC Agrícola. These indicators aim to capture four central dimensions of agricultural climate adaptation: (i) land use and adoption of resilient practices; (ii) conservation of water and biological resources; (iii) yield stability under shocks; and (iv) adaptive management capacity.

Table 3. Climate adaptation indicators adapted for Brazilian agriculture.

Dimension	Adapted Indicator	Relevance for the Sector	Practical Application
Land use	% of area under regenerative practices.	Signals degree of transition and sustainability of agricultural landscapes.	Criterion for environmental certifications; baseline for Payment for Environmental Services (PES); monitoring in green taxonomies.
Productive diversity	% of area under crop rotation or crop-livestock integration.	Reduces climate risks and improves ecological stability.	Eligibility for adaptive rural credit; component of programs such as *RenovAgro.*
Soil/water conservation	% of area with soil cover or conservation practices (e.g., no-tillage).	Reduces erosion, improves infiltration, and retains soil moisture.	Indicator for parametric agricultural insurance and water risk analysis.
Adaptive management	Presence/absence of changes in agricultural calendar.	Proxy for response capacity to climate variability.	Metric of operational robustness; criterion for long-term credit and insurance programs.
Adapted varieties	Use of drought- or pest-resistant cultivars.	Reinforces yield stability and robustness under shocks.	Indicator for seed registration and production risk assessment.
Resilient productivity	Interannual yield variation (mean/ standard deviation).	Directly measures the impact of climate shocks on production systems.	Index of productive resilience; criterion for sectoral ESG ratings.
Support infrastructure	Presence of irrigation or compensatory measures.	Defines physical capacity to mitigate water-related losses.	Component of water risk analysis in valuation and credit models.

The integration of these indicators into a "Climate Adaptation Index" would facilitate the development of an objective instrument to differentiate more resilient producers and companies, reduce capital costs, and direct resources more efficiently. Moreover, a recognized indicator to measure agricultural adaptation practices would support the design of financial instruments such as parametric insurance and green bonds backed by climate resilience metrics, while also enabling asset owners and managers to better evaluate risk-return profiles in the sector and identify attractive opportunities. From a regulatory perspective, such indicators would support the inclusion of regenerative agriculture in green taxonomies and public procurement programs.

Developing calculation methodologies, verification systems, and integration with public and private datasets is feasible based on existing time series (IBGE, Conab, INMET, satellite imagery) and could be scaled through partnerships between government, companies, and investors. Ultimately, transforming these indicators into financial instruments would create a virtuous cycle: regenerative practices increase resilience, resilience reduces risk, lower risk reduces capital costs, and reduced costs further incentivize adoption.

Corn, SLC Agrícola

5 Lessons and Recommendations for Promoting Regenerative Agriculture and Climate Resilience as Market Assets

The experience of SLC Agrícola demonstrates that regenerative practices, when adopted systematically and in combination, generate impacts beyond the environmental aspects, producing tangible operational and financial results. Interannual yield stability, reduced dependence on volatile global input markets, and mitigation of losses in critical years not only strengthen operational competitiveness but also reduce the perceived risk for financiers and investors. In a context where climate risk pricing in the agricultural sector remains incipient, these elements of production predictability and cost efficiency become intangible assets with the potential for direct valuation gains in land prices, discount rates applied to cash flows, eligibility for green financial instruments, and access to sophisticated investors.

Beyond the evidence from SLC Agrícola, international experience and examples from other groups in Brazil suggest that regenerative agriculture only scales when institutional and market preconditions are in place. Among these are i) continuous technical assistance and training for adaptive management; ii) integration with supply chains that recognize and remunerate environmental attributes; iii) regulatory clarity and explicit inclusion in green taxonomies and climate finance mechanisms; and iv) alignment with international disclosure frameworks such as Science Based Targets Initiative (SBTi) and the Taskforce on Nature-related Financial Disclosures (TNFD). The adoption of such frameworks facilitates integration of the indicators proposed in this report into financial instruments and public policies, while positioning agricultural companies to meet future disclosure requirements and eligibility criteria in capital markets.

SLC Agrícola's alignment with these frameworks also suggests that climate resilience and native vegetation protection should be treated in an integrated manner. For example, SLC Agrícola has adopted a deforestation and conversion-free (DCF) policy for new areas. While regenerative agriculture ensures productive stability, the no-conversion policy ensures that these gains are not offset by deforestation-related emissions. For financiers and regulators, jointly recognizing regenerative practices and land-use commitments can help differentiate producers that are more resilient to the physical impacts of climate change and aligned with the low-carbon transition. However, this understanding is still insufficiently incorporated into corporate valuation.

Based on these analyses, several lessons emerge regarding the challenges, with direct implications for investors, public policy, and climate governance:

Resilience as an invisible value asset.

Regenerative practices demonstrate the ability to reduce revenue volatility and operating costs, but such stability is not yet widely reflected in the risk-return metrics used by financiers and analysts. If the financial sector continues to price agricultural operations based only on historical averages of yields and prices—without considering adaptive resilience indicators—it misses the opportunity to differentiate superior operational performance and reduce risk premiums. This perspective also disregards important opportunities that could translate into added value.

Measurement as the entry point to long-term capital.

Consistent indicators of climate resilience can be directly integrated into credit risk assessment models, agricultural insurance, and sustainability ratings. Examples include yield stability, the proportion of land under combined regenerative practices, and operational robustness in rainfed systems. A national measurement, reporting, and verification (MRV) system incorporating such metrics would enable differentiated credit pricing, reduced capital costs, and access to international climate finance.

Integration of adaptation into competitiveness strategies.

The absence of a regulatory framework for regenerative agriculture hinders its formal inclusion in policies and market instruments. However, companies that internalize resilience metrics and transparently disclose such data are likely to capture early competitive advantages: access to supply chains with stricter environmental requirements, potential monetization of ecosystem services, and strengthened corporate reputation with stakeholders and institutional investors.

Cotton Seedling, SLC Agrícola

Considering this, possible recommendations for building an enabling environment to channel investment toward regenerative agriculture include:

1 Incorporate adaptive resilience metrics into risk and return assessments.

Integrate indicators such as interannual yield variation, proportion of land with combined regenerative practices, and operational robustness in rainfed systems into credit risk models, agricultural insurance, and asset valuation. This would allow differentiation of more resilient producers and companies, adjusting interest rates, insurance premiums, and market multiples. While validation of these metrics still depends on advances in measurement protocols and auditable historical data, feasible starting points already exist public datasets, remote sensing, and corporate time series verified through certifications can serve as initial proxies.

2 Establish a national MRV protocol that unites physical, economic, and management metrics.

Develop a measurement, reporting, and verification system that can track operational gains, input efficiency, and yield stability, as well as ecosystem services such as soil carbon sequestration. The protocol should have viable implementation costs and allow independent auditing, ensuring trust from financiers and buyers.

3 Create financial instruments that monetize resilience.

Design credit lines, parametric insurance, and green bonds that use resilience indicators as eligibility criteria or for differentiated pricing. This creates a virtuous cycle: regenerative practices reduce risk, lower risk reduces capital costs, and lower costs drive adoption.

4 Formalize the operational concept of regenerative agriculture in national regulation.

Clearly define scope and minimum metrics for classification as regenerative agriculture, integrating environmental, productive, and economic dimensions. This would facilitate inclusion in green taxonomies, public procurement policies, and supply chain commitments.

5 Strengthen transparency and voluntary disclosure.

Encourage companies and producers to report resilience metrics in annual reports, including impacts on operating margins, input efficiency, and revenue stability. Such transparency anticipates regulatory trends and increases attractiveness to institutional investors.

Regenerative agriculture in Brazil must be treated as a vector of competitive advantage and risk management, not merely as an environmental agenda. Translating agronomic evidence into market-recognized metrics will allow productive resilience to be integrated into credit flows, insurance, and asset valuation. This requires producers, financiers, and policymakers to advance together in creating mechanisms for monetization and risk differentiation. Ultimately, recognizing and pricing climate resilience is a value management decision in agribusiness.

Glossary

Brachiaria – A tropical forage grass widely used in Brazil, particularly in crop-livestock systems, to provide soil cover, enhance biomass and improve soil structure.

Cerrado – Brazil's tropical savanna biome, one of the world's biodiversity hotspots and an important agricultural frontier, especially for soybean, maize, and cotton.

Conab – Brazil's National Supply Company, responsible for official data on agricultural production, crop monitoring, and supply forecasts.

Crop-livestock integration systems – System where cropping and livestock are combined on the same land, either sequentially or simultaneously, to enhance soil fertility, diversify production, and increase resilience.

Embrapa – Brazilian Agricultural Research Corporation, a leading public research institution that develops and promotes technologies for sustainable agriculture.

IBGE – Brazil's national statistics agency, responsible for demographic, economic, and agricultural data collection and surveys.

INMET – Brazil's National Institute of Meteorology, providing official weather, climate, and agroclimatic monitoring data.

Invernada – Extended rainy season in Brazil, which can delay planting or harvesting and increase vulnerability of crops to pests and diseases.

MAPA – Brazil's Ministry of Agriculture and Livestock, which designs and implements agricultural policies, including those for climate adaptation and low-carbon practices.

No-tillage (System) - Seeds are sown directly into untilled soil, with crop residues left as mulch. Considered a cornerstone of conservation and regenerative agriculture in Brazil.

Organic fertilization – Practice of applying organic inputs (e.g., manure, compost) to improve soil fertility, structure, and water retention.

Regenagri – An international certification program for regenerative agriculture that verifies the adoption of practices enhancing soil health, biodiversity, carbon sequestration, and water and energy management. Farms certified under Regenagri must commit to continuous improvement and present plans to expand regenerative practices over time.

RenovAgro – Brazil's main federal rural credit program for financing low-carbon and climate-adaptive agricultural practices. It is the successor to the ABC Program, which first introduced credit lines for sustainable practices such as no-tillage, crop-livestock integration, soil carbon sequestration, and water management.

Santa Fé System – Brazilian intercropping model that combines maize with Brachiaria forage grasses to generate soil cover, improve biomass production, and integrate livestock grazing, enhancing resilience in tropical soils.

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Cover crop, SLC Agrícola

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