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The "Soybeanization" of Agrarian Reform Settlements in Sant'Ana do Livramento/RS: Socioeconomic Dynamics and Productive Reconcentration

Bunde, A. [1]; Viana, J. G. A. [1]; Santos, M. de A. dos [2]

[1] *Universidade Federal do Pampa, Sant'Ana do Livramento, Rio Grande do Sul, Brasil*

[2] *Universidade Federal de Santa Maria (UFSM), Santa Maria, RS, Brasil*

Abstract

The expansion of soybean monoculture in agrarian reform settlements in Sant'Ana do Livramento - RS represents a structural change in the productive dynamics of the Pampa biome, marking the transition from diversified family farming to a subordinated integration into global commodity chains. This study aimed to analyze the socioeconomic and structural profile of settlers, identifying the economic motivations and limiting factors sustaining soybean production in these areas. The research adopted a mixed-methods approach, administering 149 questionnaires in 24 of the 30 settlements in the municipality, covering 907 plots. The study used stratified sampling across settlements to represent the diversity of productive units. The data were analyzed using descriptive statistical techniques and hypothesis testing to identify patterns of scale, asymmetry in land occupation, and the main economic drivers and constraints associated with production. The results reveal that 84.6% of the plots cultivate soybeans, while 53.6% operate under leasing or partnership arrangements, transferring production management to third parties. The study identified severe internal concentration: only 6% of plots control 50% of the cultivated area, indicating a process of "reconcentration" within the agrarian reform space. Higher profitability is the main economic driver, whereas inadequate infrastructure and climatic instability represent the most significant constraints. The study concludes that a significant institutional gap exists, evidenced by the near absence of public technical assistance (1.4%) and the direct dependence on cooperatives and private companies, which compromises peasant autonomy and long-term socio-environmental sustainability.

Keywords: land reform, soy expansion, pampa biome, social differentiation, agribusiness

Editor

Gabriel Oyhantçabal
Universidad de la República, Facultad de Agronomía, Montevideo, Uruguay

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Correspondence

Altacir Bunde
altacirbunde@unipampa.edu.br

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La “sojización” de los asentamientos de reforma agraria en Sant’Ana do Livramento/RS: Dinámicas socioeconómicas y reconcentración productiva

Resumen

La expansión del monocultivo de soja en los asentamientos de reforma agraria de Sant’Ana do Livramento - RS representa un cambio estructural en la dinámica productiva del bioma Pampa, marcando la transición de una agricultura familiar diversificada hacia una integración subordinada a las cadenas globales de commodities. Este estudio tuvo como objetivo analizar el perfil socioeconómico y estructural de los asentados, identificando las motivaciones económicas y los factores limitantes que sustentan la producción de soja en estas áreas. La investigación adoptó un enfoque mixto, con la aplicación de 149 cuestionarios en 24 de los 30 asentamientos existentes en el municipio, que, en conjunto, suman 907 lotes. El muestreo se estratificó entre los asentamientos para representar la diversidad de unidades productivas. Los datos fueron analizados mediante técnicas de estadística descriptiva y pruebas de hipótesis, con el objetivo de identificar patrones de escala, asimetrías en la ocupación del área y los principales factores económicos y limitantes asociados a la producción. Los resultados revelan que 84,6 % de los lotes cultivan soja y 53,6 % operan bajo sistemas de arrendamiento o de asociación, transfiriendo la gestión productiva a terceros. Se identificó una fuerte concentración interna, en la que solo 6 % de los lotes controla 50 % del área cultivada, lo que evidencia un proceso de «reconcentración» dentro del espacio de la reforma agraria. La mayor rentabilidad constituye el principal motor económico, mientras que la precariedad de la infraestructura y la inestabilidad climática se erigen en las principales limitantes. Se concluye que existe un vacío institucional significativo, evidenciado por la casi inexistencia de asistencia técnica pública (1,4 %) y por la dependencia directa de cooperativas y empresas privadas, lo que compromete la autonomía campesina y la sostenibilidad socioambiental a largo plazo.

Palabras clave: reforma agraria, sojización, bioma pampa, diferenciación social, agronegocio

A “sojização” dos assentamentos de reforma agrária em Sant’Ana do Livramento/RS: Dinâmicas socioeconômicas e reconcentração produtiva

Resumo

A expansão da monocultura da soja nos assentamentos de reforma agrária em Sant’Ana do Livramento–RS representa uma mudança estrutural na dinâmica produtiva do Bioma Pampa, marcando a transição da agricultura familiar diversificada para a integração subordinada às cadeias globais de *commodities*. Este estudo buscou analisar o perfil socioeconômico e estrutural dos assentados, identificando as motivações econômicas e os fatores limitantes que sustentam a produção de soja nessas áreas. A pesquisa adotou uma abordagem mista, com a aplicação de 149 questionários em 24 dos 30 assentamentos existentes no município, totalizando 907 lotes. A amostragem foi estratificada entre os assentamentos, de modo a representar a diversidade de unidades produtivas. Os dados foram analisados por meio de técnicas de estatística descritiva e de testes de hipótese, com o objetivo de identificar padrões de escala, assimetria na ocupação da área e os principais fatores econômicos e limitantes associados à produção. Os resultados revelam que 84,6% dos lotes cultivam soja; 53,6% utilizam sistemas de arrendamento ou parceria, transferindo a gestão produtiva a terceiros. Identificou-se uma concentração interna severa, na qual apenas 6% dos lotes detêm 50% da área cultivada, o que evidencia uma "reconcentração" no espaço da reforma agrária. A maior rentabilidade é o principal motor econômico, enquanto a precariedade da infraestrutura e a instabilidade climática são os principais fatores limitantes. Conclui-se que há um expressivo vácuo institucional, evidenciado pela quase inexistência de assistência técnica pública (1,4%) e pela dependência direta de cooperativas e empresas privadas, o que compromete a autonomia camponesa e a sustentabilidade socioambiental a longo prazo.

Palavras-chave: reforma agrária, sojização, bioma pampa, diferenciação social, agronegócio

1. Introduction

The municipality of Sant'Ana do Livramento, Rio Grande do Sul, Brazil, with an area of 6,946.407 km², has historically been characterized by a profile of "demographic emptiness," with a rural population density below 1 inhab/km² in 2023 (Instituto Brasileiro de Geografia e Estatística [IBGE], n.d.). This feature directly reflects the region's land structure, dominated by large rural properties originating from sesmarias and an economic model based on extensive cattle ranching. However, this reality began to change gradually from the 1990s onward.

The settlement projects, defined by the Instituto Nacional de Colonização e Reforma Agrária (INCRA, n.d.) as agricultural units intended to support landless families, have been the main driver of agrarian transformation in the region. After the first settlement in 1992, the region expanded significantly between 1996 and 1998, with the creation of 12 new settlements as part of the compensatory policy of the Fernando Henrique Cardoso administration (Fernandes, 2009; Monteblanco & Cordeiro, 2019). Subsequently, between 1999 and 2002, the state government established another nine State Settlement Projects.

The growing presence of the Landless Rural Workers' Movement (MST) in the Campanha Gaúcha from the 1990s onward sparked debates on the productivity of extensive cattle ranching and, in 2003, the municipality of Sant'Ana do Livramento became an organizing hub for the movement. Pressure from the MST led to the creation of eight new settlements between 2005 and 2008, bringing the total to 30 projects (Fernandes, 2009; Monteblanco & Cordeiro, 2019).

The municipality's settlements are mostly located in the eastern region, known for its soils suited to agriculture (Aguiar, 2011). This area currently concentrates 907 settled families, representing about 40% of the rural population, although they occupy less than 5% of the municipality's rural territory. This spatial concentration and the geo-environmental conditions facilitated the expansion of crops such as soybeans, highlighting the complex interaction between natural factors, public policies, and agricultural development.

This expansion is directly linked to the international appreciation of soybeans as a strategic commodity and to the replacement of diversified production systems by intensive monocultures. According to Silva (2001) and Delgado (2005), the agro-industrial sector and public and private financing mechanisms that favor the agribusiness model drive this process. The growth of the area cultivated with soybeans reflects not only technological advances, such as the use of adapted seeds, but also the consolidation of a new pattern of territorial occupation.

Soybeans, which were initially a rotation crop with irrigated rice (Fortunel et al., 2025), became a structuring factor of municipal agriculture. This change has significant socioeconomic implications for producers of all sizes, redefining productive dynamics and sustainability in the territory. Against this backdrop, the research sought to answer the following question: what economic, technical, and environmental factors drive the adoption and production of soybeans in the settlements of Sant'Ana do Livramento - RS, and how does this productive specialization affect the socioeconomic autonomy of settled families? Accordingly, the research aimed to identify the factors driving soybean expansion in the agrarian reform settlements of Sant'Ana do Livramento - RS.

It is hypothesized that the introduction of soybeans in the settlements is motivated by economic incentives, such as specific credit lines, and by the action of cooperatives and agribusiness companies. This trend, however, clashes with the original goals of agrarian reform, which aimed at social justice and at fostering family farming and food security. The adoption of monoculture, intensive in industrialized inputs, pesticides, and machinery, not only raises production costs but also compromises the economic, social, and environmental sustainability of settled families, potentially generating dependence on large corporations.

2. Materials and Methods

Located in the Campanha Gaúcha and part of the Pampa biome, the municipality of Sant'Ana do Livramento lies on the border with Uruguay, in a dry-border area with the Uruguayan city of Rivera. Geographically, it is located at 30°53'27" S and 55°31'58" W, at an altitude of 208 meters. The municipality is 498 km from Porto Alegre and 500 km from Montevideo (IBGE, n.d.) (Figure 1).

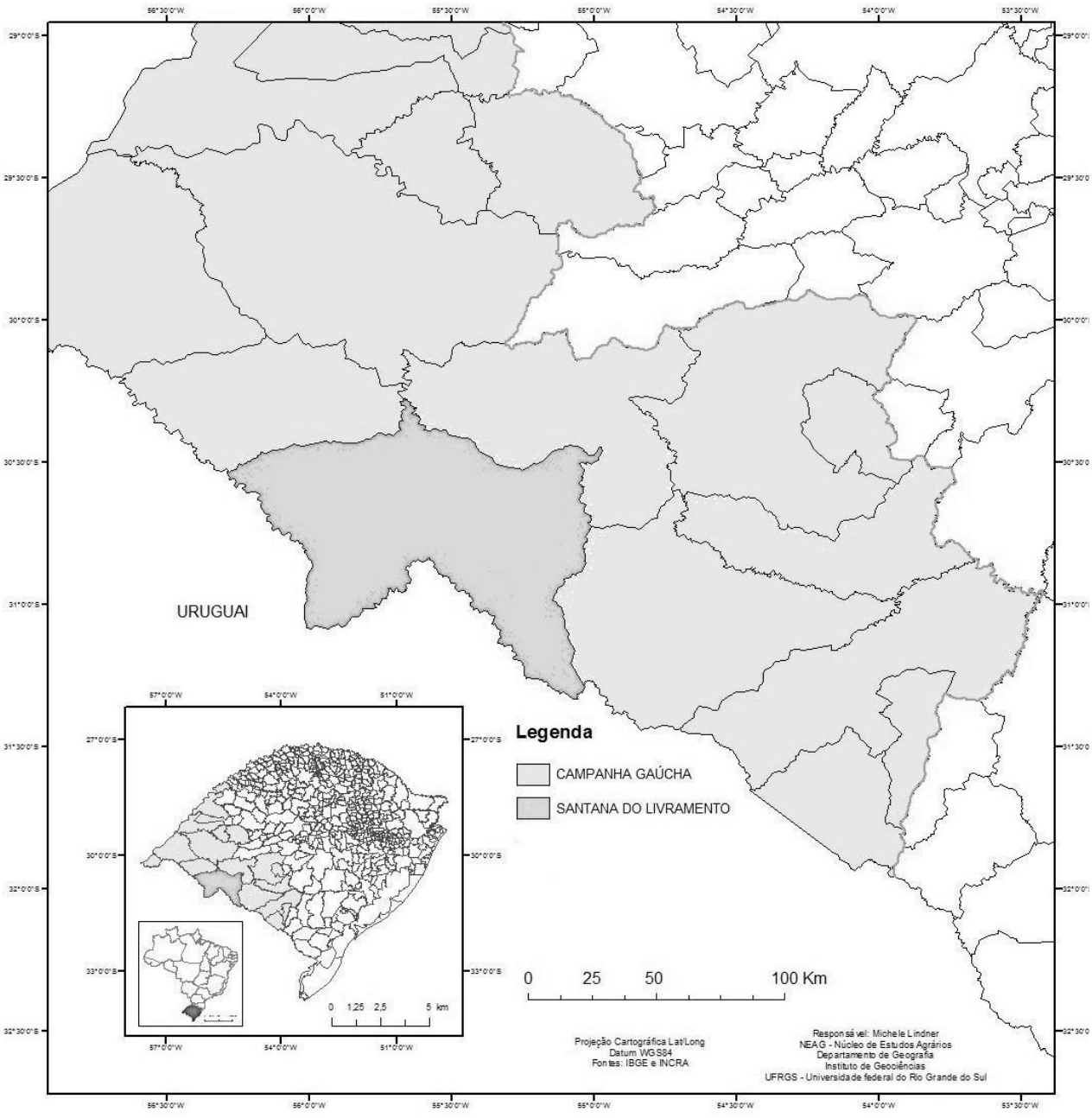


Figure 1. Location map, Sant'Ana do Livramento - RS

Source. Monteblanco and Cordeiro (2019, p. 60).

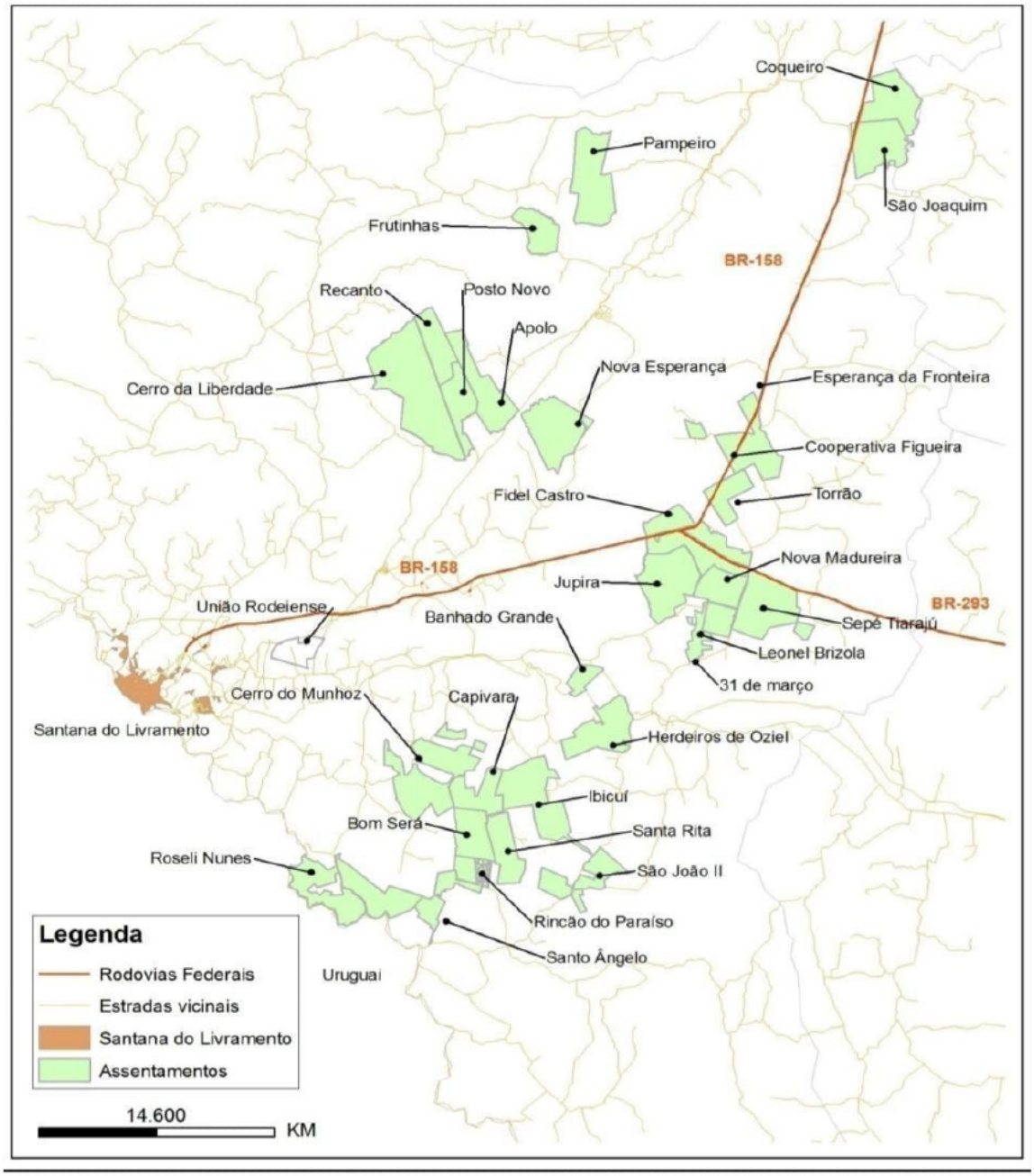


Figure 2. Settlements map, Sant'Ana do Livramento - RS

Source. Aguiar (2011, p. 34).

Identified by Monteblanco and Cordeiro (2019) as the "cropland portion," the eastern region of the municipality is where the agrarian reform settlement projects in Sant'Ana do Livramento are located (Figure 2), popularly known as "the sandy side." In this area, small relative to the municipality's proportions but considerable compared with the size of many small Brazilian municipalities, there currently reside –with variations due to departures and turnover– 907 settled families, totaling approximately 3,000 people. Although this population occupies less than 5% of Sant'Ana do Livramento's total area, it represents about 40% of the municipality's rural population (Monteblanco & Cordeiro, 2019).

The research was descriptive and explanatory, using qualitative and quantitative approaches within a mixed-methods design. This approach enables an integrated analysis of interactions among economic, social, and environmental systems, yielding more complete diagnoses. The sampling plan was defined from a universe of 907 agricultural plots linked to agrarian reform settlement projects in the municipality of Sant'Ana do Livramento

- RS. Using a 95% confidence level and a 5% margin of error, we established a sample of 149 sampling units, previously organized into five strata to ensure the representativeness of the different existing profiles (Table 1).

Table 1. Stratified sampling plan of the research

Stratum	Plot population	Percentage (%)	Sample
Stratum 1	168	18.52	27
Stratum 2	189	20.84	31
Stratum 3	190	20.95	31
Stratum 4	189	20.84	32
Stratum 5	171	18.85	28
Total	907	100	149

The field research was carried out in 24 agrarian reform settlements in the municipality through the in-person administration of 149 questionnaires to representatives of the selected plots, between April 5 and May 21, 2025, across seven field visits.

The data-collection instrument aimed first to identify the profile of settlers who produce soybeans and, subsequently, to investigate the motivations for adopting or not adopting this crop in each settlement. To collect primary data, the research was presented to the leadership of the Landless Rural Workers' Movement (MST) and the leaders of each settlement, ensuring participants' collaboration and the collection of representative information.

The primary data collected were organized in an Excel spreadsheet. The analysis used descriptive statistics to collect, organize, and summarize data, providing an overview of patterns before applying inferential statistical techniques. The analysis used graphical representations and measures of variability. To assess factors associated with the decision to cultivate soybeans, we used seven-category ordinal Likert scales. For the economic factors that influenced the decision to plant soybeans, respondents indicated the perceived importance of each factor on a scale ranging from "not important at all" to "very important."

As a complement, we assessed the limiting factors for soybean production using a seven-category Likert scale ranging from "no limitation" to "total limitation," capturing the perceived intensity of the constraints settlers faced in developing the activity.

Given the ordinal nature of the scales used, we employed nonparametric statistical methods. We analyzed differences among the evaluated factors using the Kruskal-Wallis test. We reported the test statistic, degrees of freedom (df), and sample size (N = 126 for soybean producers and N = 23 for non-producers). This was followed by Dunn's post hoc test with Bonferroni correction, adopting a significance level of 5% ($\alpha = 0.05$). In the qualitative analysis, relevant studies from the literature were used to discuss and reinterpret the findings through different disciplinary perspectives.

3. Results

3.1 Socioeconomic and Structural Profile of the Settlers

The demographic characterization of the 149 settlers who participated in the research in Sant'Ana do Livramento - RS reveals a sample of individuals aged 18 to 84 years. Regarding gender composition, males predominate, with 87 representatives (58.4%) compared with 62 female representatives (41.6%). This age and gender

structure highlights the diversity of individuals involved in managing the productive units, ranging from young people of working age to those in retirement, all integrated into the dynamics of the settlements.

Regarding territorial stability and the composition of family units, the results indicate an average length of residence on the plots of 18.8 years, with a range of 2 to 34 years. This indicates a consolidated process of families settling on the land over the past decades. In addition, each plot houses, on average, three people, reflecting the labor force available for agricultural activities, predominantly organized around the family structure. Table 2 summarizes the socioeconomic and structural profile of agrarian reform settlers in Sant'Ana do Livramento - RS.

Table 2. Summary of the socioeconomic and structural profile of the agrarian reform settlers, Sant'Ana do Livramento - RS, 2025

Variable	Result
Total sample	149 settlers
Age range	18 to 84 years
Gender	Male (87) and female (62)
Average length of residence	18.8 years
Average household density	3 people per plot
Average plot size	26.2 hectares
Range of plot sizes	17 to 40 hectares
Diversity of origin	67 distinct cities
Main cities of origin	Sant'Ana do Livramento, Palmeira das Missões, Rosário do Sul, Cruz Alta, and Ronda Alta

Regarding the physical size of the production units, the surveyed plots range from 17 to 40 hectares, averaging 26.2 hectares per family. This land configuration, determined by the region's agrarian reform guidelines, delimits the productive scale and the possibilities for soil management. The observed average size serves as a basis for planning economic activities, directly influencing the viability of mechanized crops and of extensive or intensive cattle ranching.

Finally, the analysis of the settlers' geographic origin reveals a heterogeneous migratory flow, with families coming from 67 distinct municipalities. Although local origin (Sant'Ana do Livramento) is the most frequent, representing 14.1% of the sample (n = 21), there is a significant share of migrants from traditional agricultural hubs of Rio Grande do Sul, such as Palmeira das Missões (n = 9), Rosário do Sul (n = 8), Cruz Alta (n = 7), and Ronda Alta (n = 6). This population mosaic also includes individuals from other states, such as Santa Catarina and Maranhão, demonstrating that the local settlements function as convergence centers for different rural trajectories and experiences.

3.2 Dynamics and Modalities of Soybean Production

The analysis of the productive matrix in the settlements of Sant'Ana do Livramento - RS reveals a marked hegemony of soybean cultivation. Of the 149 research participants, 126 individuals (84.6%) confirmed that they produce or have produced the oilseed on their plots, consolidating it as the predominant agricultural activity. In contrast, a minority, 15.4% of families (n = 23), reported never having introduced soybean cultivation in their production units, remaining on the margins of this productive specialization.

Regarding management and direct control over the land, the data point to fragmentation in modes of exploitation. While 46.5% of settlers cultivate soybeans on their own, managing the full production cycle, a significant share of 53.6% opt to outsource the area. The latter is divided between the leasing system, adopted by 38.6% of respondents, and the partnership arrangement, used by 15% of the sample. In addition, 38.3% of producers do

not restrict their activity to the settlement boundary and also cultivate soybeans in external areas or on third-party plots. Table 3 shows the dynamics and modalities of soybean production by agrarian reform settlers in Sant'Ana do Livramento - RS in the 2024/2025 harvest.

Table 3. Dynamics and modalities of soybean production by agrarian reform settlers, Sant'Ana do Livramento - RS

Variable	Result
Soybean producers (current or former)	84.6% (126 people)
Non-producers of soybeans	15.4% (23 families)
Own production	46.50%
Leasing	38.60%
Partnership	15.00%
Production in areas outside the plot	38.30%
"Open year" modality (leasing)	56.10%
"Closed year" modality (leasing)	43.90%
Average leasing payment	8.72 bags/ha
Payment range	6 to 12 bags/ha

Among the leasing modalities identified, two distinct contractual logics coexist. Most settlers (56.1%) use the "open year" system, characterized by lower payments in bags of soybeans and the flexibility to use the area for cattle ranching during the off-season (autumn/winter). In contrast, 43.9% establish "closed year" contracts, in which full control of the area is transferred to third parties for soybean cultivation in summer and pasture in winter, for a fixed amount. The average payment received by lessors is 8.72 bags per hectare, fluctuating between 6 and 12 bags per hectare depending on soil fertility and the type of contract signed.

3.3 Scale and Asymmetry of the Cultivated Area

The total area allocated to soybean cultivation in the surveyed settlements amounted to 8,389.5 hectares among the 126 active producers. Based on the reported cultivated area, the mean area operated per producer was 66.58 hectares, substantially exceeding the mean size of individual plots (26.2 hectares) identified in the socio-demographic characterization. This discrepancy suggests that soybean production extends beyond the nominal area allocated to each family, potentially involving the aggregation of multiple plots through land leasing or partnership arrangements.

The data reveal extreme heterogeneity in the size of individual operations, ranging from small-scale cultivation of only 5 hectares to large-scale ventures of up to 1,000 hectares of planted soybeans. This diversity of productive scales suggests different levels of capitalization, access to machinery, and investment capacity among settlers, thereby outlining distinct socioeconomic profiles within the same agrarian reform structure. Table 4 presents the scale and asymmetry of soybean production among agrarian reform settlers in Sant'Ana do Livramento - RS.

The analysis of the distribution of planted area reveals marked asymmetry and internal concentration of soybean production. An expressive minority of 6% of all plots account for 50% of the total area allocated to soybean cultivation in the studied sample. In contrast, the vast majority of settlers, corresponding to the remaining 94%, own and manage the other 50% of the planted area, reflecting inequality in the productive territorial occupation of the settlements in the municipality.

Table 4. Scale and asymmetry of soybean production by the agrarian reform settlers, Sant'Ana do Livramento - RS, 2025

Variable	Result
Total cultivated area (sample)	8,389.5 hectares
Number of producers	126 settlers
Average area per producer	66.58 hectares
Minimum cultivated area	5 hectares
Maximum cultivated area	1,000 hectares
Concentration (productive elite)	6% of plots hold 50% of the total area
Distribution (productive base)	94% of plots hold 50% of the total area

This statistical disparity reveals a process of internal socioeconomic differentiation, in which a small stratum of settlers –the 6% productive elite– operates at scales that no longer resemble the original size of the family plot. This phenomenon is largely driven by area aggregation, in which these producers expand their cultivated area by leasing or partnering on neighboring plots. At the same time, most settlers (94%) maintain subsistence or small-scale production limited to their original perimeters, while a minority centralizes capital, access to high-performance machinery, and marketing capacity, creating a scenario of "productive reconcentration" within the agrarian reform territories in Sant'Ana do Livramento - RS.

3.4 Economic Factors Associated with Soybean Adoption and Productive Constraints in the Settlements

The Kruskal-Wallis nonparametric test revealed statistically significant differences among the economic factors associated with soybean adoption in the settlements of Sant'Ana do Livramento, Rio Grande do Sul, Brazil ($H = 48.32$, $df = 4$, $p < 0.001$, $N = 126$), as well as among the factors limiting soybean production ($H = 52.14$, $df = 4$, $p < 0.001$, $N = 126$). We assessed the factors using seven-point ordinal Likert-type scales. For economic factors, the scale ranged from 1 (not at all important) to 7 (very important), whereas for limiting factors, it ranged from 1 (no limitation) to 7 (complete limitation). Multiple comparisons using Dunn's post hoc test identified a clear hierarchy among the evaluated factors (Table 5).

Table 5. Economic and limiting factors associated with the adoption and development of soybean production in the settlements of Sant'Ana do Livramento - RS, 2025

Dimension	Factor	Scale mean*
Economic factors	Higher profitability	6.04[a]
	Pressure from family, neighbors, and companies	5.25[a]
	Lower workload	4.83[b]
	Ease of access to credit	4.39[b]
	Cooperative technical assistance	3.61[c]
Limiting factors	Climatic conditions	6.37[a]
	Lack of infrastructure	5.94[a]
	Initial cost	5.26[b]
	Technical adaptation	4.40[c]
	Pest and disease management	4.31[c]

Note. *Different letters indicate statistically significant differences ($p<0.05$) by Dunn's post-hoc test with Bonferroni correction.

In the analysis of the economic factors associated with soybean adoption in the settlements, the predominance of "higher profitability" as the main driver is observed, which showed the highest value on the importance scale

(6.04), belonging to the group of greatest statistical significance (Group A), together with "pressure exerted by family members, neighbors, and companies" (5.25). These findings indicate that the decision to incorporate soybeans into productive systems is strongly guided by expectations of economic return, while also being influenced by social and institutional pressures that go beyond a purely productive logic.

At an intermediate level of influence (Group B) are the factors "lower workload" (4.83) and "ease of access to credit" (4.39), suggesting that operational and financial aspects contribute to the crop's adoption, though with less relative weight than expected profitability. In turn, "cooperative technical assistance" showed the lowest scale mean (3.61), constituting Group C on its own, which highlights its reduced perceived relevance in the settlers' productive decision.

After analyzing the economic factors influencing the introduction of soybean cultivation in the settlements, it is essential to assess the main limiting factors for the crop's development on the plots, since the decision to adopt it does not necessarily translate into structural conditions conducive to productive consolidation. Among the limiting factors, "climatic conditions" (6.37) and "lack of infrastructure" (5.94) made up Group A, which settlers perceived as the most severe barriers to soybean production. These results highlight the high vulnerability of productive systems to the region's climatic variability and to structural deficiencies that shape the functioning of production units.

The "initial cost of the activity" showed a limitation of intermediate intensity (Group B). At the same time, the factors "technical adaptation" (4.40) and "pest and disease management" (4.31) were classified in Group C, indicating lower relative severity. Overall, the results suggest that the main obstacles to soybean production in the settlements are not related to agronomic management itself, but to environmental and structural factors beyond the settlers' direct control.

3.5 Limiting Factors and Barriers to Production

This section examines the motivations of the 23 families (15.4% of the total sample, N = 149) that chose not to introduce soybean cultivation on their plots. Of these 23 non-producing families, 21 provided valid responses to questions about their reasons for not cultivating soybeans. The findings suggest that the decision to refrain from soybean cultivation is primarily associated with concerns about the impacts of monoculture.

Environmental concerns were the most frequently reported motivation, cited by 66.7% of valid respondents (n = 14 of 21). These concerns included preserving natural resources, potential pesticide contamination, and maintaining soil health. For these families, such considerations appear to outweigh the perceived short-term income opportunities associated with commodity production.

Economic and institutional motivations were also identified. Perceived low profitability or the economic unfeasibility of soybean production at a small scale was the second most frequently reported reason, cited by 14.3% of valid respondents (n = 3 of 21). This finding suggests that, for some settlers, the available production scale and associated cost structure may make soybean cultivation financially unattractive. Limited access to credit was the main obstacle for 9.5% of respondents (n = 2 of 21), indicating that financial constraints may also hinder entry into soybean production.

Finally, cultural considerations and personal preferences concerning production autonomy accounted for the remaining 9.5% of responses (4.8%, n = 1 each). These motivations may reflect an attachment to traditional diversified farming practices and a preference for maintaining control over production decisions. The motivations for not cultivating soybeans are presented in Figure 3.

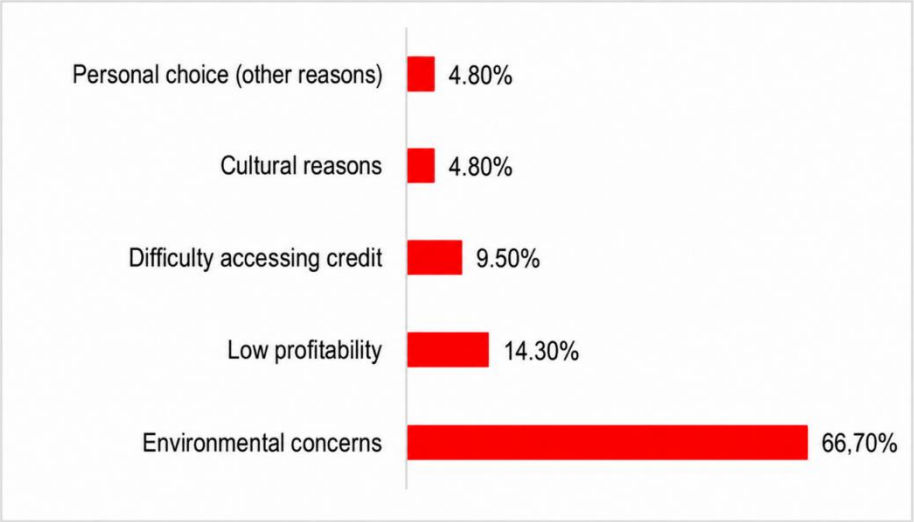


Figure 3. Motivations for not cultivating soybeans among agrarian reform settlers in Sant'Ana do Livramento, Rio Grande do Sul, Brazil

In summary, the results demonstrate that resistance to soybeans in the settlements of Sant'Ana do Livramento - RS is not merely a reflection of technical limitations but a strategic choice aimed at preserving peasant ways of life and mitigating socio-environmental risks.

4. Discussion

The socioeconomic and structural profile of agrarian reform settlers in Sant'Ana do Livramento, Rio Grande do Sul, Brazil, points to a process of agrarian territorialization (Chelotti, 2009; Chelotti & Hespanhol, 2003). The diversity of origins, encompassing 67 municipalities, reflects the historical movement of peasant families from established agricultural regions, such as Alto Uruguai and Missões, toward the Campanha Gaúcha. This pattern aligns with analyses by Mendonça (2013) and Fernandes (2004, 2009) on the formation of socio-spatial mosaics and the transfer of grain-farming practices to areas traditionally dominated by livestock production. At the same time, the mean individual plot size of 26.2 hectares may constrain the economic viability of mechanized soybean monoculture, particularly where production depends on economies of scale. As Silva (1982) and Delgado (2005, 2012) discuss, agricultural modernization can pressure small-scale farming units to integrate into agro-industrial commodity chains under unequal conditions, potentially affecting their capacity for social and economic reproduction.

The high prevalence of soybean cultivation (84.6%) and the importance of land-use transfer arrangements (53.5% of producers, comprising 38.5% leasing and 15.0% partnership arrangements) align with agribusiness expansion through indirect control over production and land use (Oliveira, 2010; Sauer, 2010). However, these contractual arrangements require careful interpretation. The temporary transfer of land-use rights through leasing or partnerships does not, in itself, establish that settlers constitute a consolidated rentier class or operate as autonomous financial agents. Rather, such arrangements may represent strategies for maintaining household livelihoods under constraints related to capital, machinery, and infrastructure. Similarly, the decision to cultivate soybeans or transfer land use for this purpose should not be understood solely as an individual market choice, but as one shaped by structural conditions and the surrounding institutional environment (Escher, 2016, 2019; Flexor & Grisa, 2016).

The prevalence of contractual arrangements known locally as "Ano Aberto" (open-year arrangements, 56.1%) and "Ano Fechado" (closed-year arrangements, 43.9%) illustrates how land-use agreements have adapted to

the production conditions of the Campanha Gaúcha. Open-year arrangements allow complementary land use for summer cropping and extensive livestock production during winter. In contrast, closed-year arrangements involve transferring productive management to third parties for the agreed period. As discussed by Alentejano (2020), Grisa and Schneider (2015), and Fortunel et al. (2025), limitations in public policies supporting the diversification of family farming may increase the importance of soybean-related activities as a source of household income. In this context, both own-account production (46.5% of producers) and income obtained through land leasing (an average of 8.72 bags/ha) may contribute to the economic reproduction of settler households. However, the extent of this contribution depends on the conditions of each arrangement.

The pronounced asymmetry in cultivated area, whereby a stratum comprising 6% of plots accounts for 50% of the soybean area, suggests social differentiation within the settlements (Heredia et al., 2003; Leite et al., 2004; Martins, 1981). Nevertheless, an important analytical distinction must be maintained between formal land ownership and the concentration of land use and productive control. The pattern observed in Sant'Ana do Livramento does not necessarily imply a change in the legal tenure regime of settlement land. Rather, it points to a reconfiguration of the operational scale of soybean cultivation through plot aggregation by better-capitalized settlers or external producers (Kageyama, 2008; Stédile, 2005). This concentration of productive land use is consistent with the broader structural transformations discussed by Zanella (2023), particularly the expansion of commodity production into agrarian reform territories in southern Brazil.

The high importance attributed to "higher profitability" (mean = 6.04) and "social, family, and business pressure" (mean = 5.25) as economic drivers of soybean cultivation suggests that adoption is shaped by both expected economic returns and the integration of settlers into regional agribusiness networks (Maluf, 2007; van der Ploeg, 2014). As Wesz Junior (2014, 2019), Buainain (2007), and Buainain et al. (2014) discuss, the activities of transnational companies, grain traders, and private cooperatives contribute to an institutional environment in which access to credit, inputs, and commercialization channels is closely tied to grain production. In this context, the role of public institutions and the State should not be reduced to an institutional absence. Rather, the literature points to the importance of examining how public financing mechanisms, including PRONAF credit lines, and regulatory frameworks may provide differentiated support to agricultural activities and production systems (Mattei, 2015; Scopinho, 2007). Whether such support disproportionately favors soybean production over diversified or agroecological family farming in the study area, however, requires specific empirical evidence.

Conversely, the high severity attributed to "climatic conditions" (mean = 6.37) and "lack of infrastructure" (mean = 5.94) highlights the perceived vulnerability of agricultural production systems in the Pampa biome (Altieri, 2012; Grisa, 2012). Among the families that did not cultivate soybeans (15.4% of the total sample), environmental concerns were the most frequently reported motivation, accounting for 66.7% of valid responses. This finding suggests that socio-environmental considerations play an important role in the decision not to adopt soybean cultivation. As discussed by Schneider (2016), Souza (2023), Rech et al. (2025), and Niederle and Wesz Junior (2018), maintaining agrobiodiversity, valorizing family livestock farming, and developing short food supply chains may constitute alternative strategies of social reproduction. Such strategies can be understood as potential means of diversifying livelihoods, managing production and financial risks, and maintaining the ecological characteristics of the Pampa biome.

5. Conclusion

The findings indicate that soybean cultivation is well established in the agrarian reform settlements of Sant'Ana do Livramento, Rio Grande do Sul, Brazil, involving 84.6% of the surveyed production units. The empirical characterization shows a mean length of residence of 18.8 years and a mean individual plot size of 26.2 hectares. However, the operational scale of soybean cultivation substantially exceeds the physical size of individual plots,

reaching a mean cultivated area of 66.58 hectares per active producer. This discrepancy is consistent with land aggregation through arrangements involving the transfer of land-use rights.

The findings also reveal a pronounced concentration of productive land use and operational control, with a stratum comprising 6% of plots accounting for 50% of the soybean area. This concentration concerns productive use rather than formal land ownership, which remains subject to the public land-tenure regime governing agrarian reform settlements. Leasing (38.5%) and partnership arrangements (15.0%) involve temporary transfers of land-use rights and agricultural management. Economic constraints and differentiated access to public and private support may shape these arrangements. Still, they should not be interpreted as evidence that land-transferring settlers constitute a consolidated rentier class.

At a broader regional and environmental level, the expansion of soybean monoculture raises important questions concerning the sustainability of production systems in the Pampa biome. Greater dependence on specialized production systems may increase exposure to adverse climatic events and fluctuations in international commodity prices. At the same time, the 15.4% of settlers who did not cultivate soybeans, primarily citing environmental concerns, demonstrate the persistence of alternative production choices. Their motivations suggest the importance of considering diversified farming systems, family livestock production, and agrobiodiversity in rural development discussions. However, further research is needed to assess the economic and environmental performance of these alternatives.

Overall, the results suggest that interactions among economic incentives, land-use arrangements, and structural and institutional conditions shape soybean expansion in the settlements. They therefore point to the importance of public policies that improve access to rural credit, technical assistance, and regional infrastructure while supporting a broader range of production strategies. Future research should examine the long-term environmental effects of soybean expansion in the Pampa, particularly changes in soil quality, and investigate how the concentration of productive land use affects intergenerational succession and rural youth retention.

Transparency of Data

Available data: The entire data set that supports the results of this study was published in the article itself.

Author Contribution Statement

	A Bunde	JGA Viana	M de A dos Santos
Conceptualization	■	■	
Data curation	■		■
Formal analysis	■	■	
Funding acquisition	■		■
Investigation	■		■
Methodology	■	■	
Project administration	■		
Resources	■	■	■
Software	■	■	
Supervision	■		
Validation	■	■	
Visualization	■	■	
Writing – original draft	■	■	■
Writing – review and editing	■	■	

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