

Comprehensive analysis of rural agro-industry and technical assistance in Pará, Brazil

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Abstract: Rural agribusiness in the state of Pará has gained recognition across Brazil for its promotion of sustainable agricultural practices, such as family farming, agroecology, and sustainable forest management. However, the current situation of Technical Assistance and Rural Extension (ATER) in the state of Pará remains a complex and weak process. This study aims to provide a comprehensive analysis of rural agribusiness and ATER in the state of Pará by analyzing the number and size of rural establishments, the profile of rural producers, the types of ATER received by producers, the rural activities carried out, and the income generated. The data used for this research was obtained from the 2017 Agricultural Census conducted by the Brazilian Institute of Geography and Statistics (IBGE). The main findings of the analysis of the local rural agro-industry scenario revealed that a total of 91,913 establishments were engaged in rural agribusiness in the state of Pará, primarily those with land areas of less than 50 hectares (75,727 establishments). Family farmers predominated, with access to programs such as PRONAF and PRONAMP. The major products included manioc flour, cheese, fruit pulp, beef, and rice grain, with cassava flour, charcoal, and rice grain also notable for their production and sales quantities. Access to ATER in Pará remains limited, reaching only 4% of agricultural establishments. ATER beneficiaries tend to belong to higher income brackets and are primarily engaged in livestock farming, while non-ATER beneficiaries are more involved in temporary crop activities. The census revealed that family farmers make up the majority of producers, with many accessing PRONAF credit lines and a smaller percentage benefiting from PRONAMP initiatives.

Keywords: Agricultural Census, ATER, family farmers, rural agribusiness.

Introduction

The rural agro-industry is a critical sector that refines agricultural raw materials into finished products, thereby increasing the commodity's value. This industry is vital to the Brazilian economy, as it generates employment and income for both rural and urban populations. Additionally, rural agro-industry caters to the global demand for food and bioenergy, making it a crucial component of developing countries. The importance of agro-industries in Brazil, particularly in the context of economic growth, food security, and poverty reduction strategies, cannot be overstated. According to the Brazilian Institute of Geography and Statistics (IBGE), every million dollars invested in agricultural and agro-industrial enterprises generates between 118 and 182 direct and indirect jobs, which is approximately 80% more than the jobs created in a labor-intensive segment like the commercial sector. (IBGE, 2007; Homma, 2007; Nichele and Waquil, 2011; Bastian et al., 2014; Favro and Alves, 2020; Wesz Junior, 2023).

In the agricultural sector of Pará, Brazil, the production of cassava flour has emerged as a prominent industry. Pará is the largest producer of cassava in Brazil, contributing significantly to the national production by 15%. Additionally, the state produces beef, dairy products, fruits, artisanal goods, rice, fruit pulps, and juices, which are strategically marketed with added value. Remarkably, Pará has committed to sustainable agricultural practices, including family farming, agro-ecology,

and sustainable forest management. This commitment has positioned the state as a leader in promoting economic development while preserving the environment, emphasizing the conservation of natural resources and biodiversity. The rural agro-industry landscape in Pará provides valuable insights into identifying key products, establishments, and producer profiles that enhance the value of raw materials for high-quality food production. This approach facilitates market expansion in an organized manner, particularly benefiting family farming (Filgueiras et al., 2006; Homma, 2007; Santos and Santana, 2012; Mattos et al., 2017; Carvalho et al., 2018; do Amaral et al., 2023; Wesz Junior, 2023).

The structuring of rural extension is intricately linked to pivotal historical epochs in human development, reflecting the evolution of social organization. In Brazil, the beginning of rural extension initiatives dates back to the late 1940s. Historically, rural areas were associated with underdevelopment, prompting the establishment of rural extension institutions driven by the aspiration for modernization. This modernization schedule was underpinned by the belief that the adoption of contemporary production techniques would enhance the quality of life for rural communities, following a model centered on technology diffusion (Oliveira, 1999; Brito et al., 2012; Peixoto, 2014; Ramos and Nodari, 2020; Cruz et al., 2023; Delgrossi et al., 2024).

In the state of Pará, rural extension has been formed by governmental actions that originated at the federal level and were subsequently adopted by the state government. The

Technical Assistance and Rural Extension Company (EMATER) in Pará is present in almost every municipality, serving as a key conduit for public Technical Assistance and Rural Extension (ATER) for small family farmers. Together with EMATER, the National Technical Assistance and Rural Extension Service (SENAR) represents another primary avenue for accessing public ATER. However, the growth of certain sectors, such as livestock, grain production, cocoa, and fruit cultivation, has necessitated the expansion of private ATER (Mattos and Santana, 2014; Araujo et al., 2020; Miranda et al., 2023).

The current state of Technical Assistance and Rural Extension (ATER) in Pará is involved in a multifaceted process characterized by a precarious operational environment, despite rhetoric advocating for innovative approaches and resolutions. Numerous challenges exacerbate this situation, including vast territorial expanses, poorly maintained infrastructure, limited technical personnel, and, in some instances, insufficient financial resources (Fornazier and Vieira Filho, 2012; Souza et al., 2015; Cerveira et al., 2022). Compounding these challenges are issues such as inadequate academic preparation of technicians and the persistent economic-social divide, which hinders the provision of necessary tools. Additionally, the distribution of funding from programs like the National Program to Strengthen Family Farming (PRONAF), the National Program to Support Medium-Sized Rural Producers (PRONAMP), and other credit lines for family and commercial farming up to the 2017 Agricultural Census remains a critical concern (IBGE, 2017a).

The primary objective of this study was to provide a comprehensive analysis of the rural agribusiness landscape and Technical Assistance and Rural Extension (ATER) in the state of Pará. This analysis aimed to evaluate the number and size of rural establishments, investigate the profile of rural producers, identify the types of ATER received by producers, assess the rural activities that were undertaken, and determine the income generated.

Results and discussion

Number of establishments, property size and producer profile

In the state of Pará, a total of 105921 establishments engaged in rural agro-industry activities were examined. Among these establishments, notable products in terms of the number of facilities include manioc flour, fruit pulp, fruit juices, cheese and curd, gum or tapioca, charcoal, and rice grain, with 78,868 (74%), 6843 (6%), 4623 (4%), 4516 (4%), 3819 (4%), 2,978 (3%), and 1,306 (1%) establishments, respectively (Figure 1). Additionally, other products like jams and jellies, vegetable oils, molasses, wood products, beef, bread, cakes, cookies, tobacco in rolls or ropes, pork, liqueurs, roasted and ground coffee are produced in 2,968 (3%) establishments.

In the state of Pará, rural agro-industry activities are carried out across a range of property sizes. Specifically, 13,487 properties have 0 to 0.9 hectares, 2,535 have 1 to 4.9 hectares, 8,879 have 5 to 9.9 hectares, 9,735 have 10 to 19.9 hectares, 20,091 have 20 to 49.9 hectares, 8,757 have 50 to 99.9 hectares, 4,183 have 100 to 199.9 hectares, 1,446 have 200 to 499.9 hectares, 379 have 500 to 999.9 hectares, 220 have 1,000 to 2,499.9 hectares, 86 have 2,500 to 9,999.9 hectares, and 17 have 10,000 hectares or more. Additionally, there are 1,098 producers in the rural agro-industry without their own land (Figure 2).

The analysis of rural producers engaged in rural agro-industry activities in Pará indicates that 8,499 (9%) of the producers are non-family farmers, while 83,414 (91%) are classified as family farmers (Figure 3A). Furthermore, the data highlights that 8,582 (9.3%) producers benefit from the National Support Program for Medium Rural Producers (PRONAMP), whereas 83,331 (90.7%) do not have access to PRONAMP (Figure 3B). Regarding the Program to Strengthen Family Farming (PRONAF), the findings show that 58,222 (69.8%) producers are affiliated with PRONAF B, 25,075 (30.1%) with PRONAF V, and only 117 (0.1%) do not participate in PRONAF initiatives (Figure 3C).

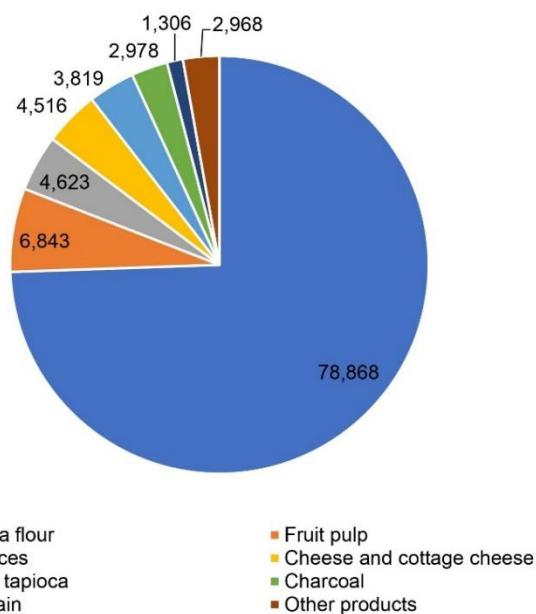


Figure 1. Number of establishments by type of rural agroindustry products in the State of Pará, Brazil.

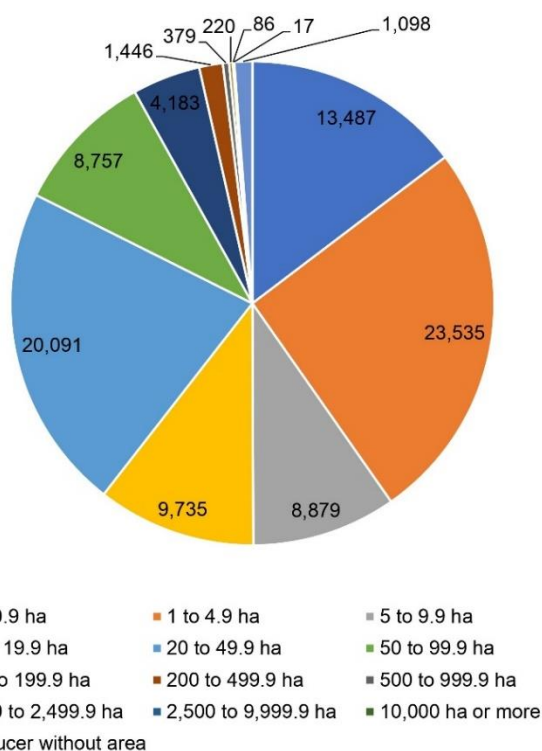


Figure 2. Size of properties by type of rural agroindustry products in the State of Pará, Brazil.

Production value and sales value of products

In terms of production value, prominent rural agro-industry products include manioc flour, cheese and curd, fruit pulp, beef, gum or tapioca, rice grain, fruit juices, and charcoal, with values of R\$ 666,129,000 (US\$ 118,448,394); R\$ 59,812,000 (US\$ 10,635,531); R\$ 47,136,000 (US\$ 8,331,534); R\$ 25,365,000 (US\$ 4,510,303); R\$ 16,720,000 (US\$ 2,973,084); R\$ 14,098,000 (US\$ 2,506,850); R\$ 13,783,000 (US\$ 2,450,838); and R\$ 7,807,000 (US\$ 1,388,210), respectively. Additionally, other rural agro-industry products collectively generated a production value of R\$ 65,779,000 (US\$ 11,700,115) (Figure 4A). Regarding sales value, notable rural agro-industry products include manioc flour, cheese and curd, fruit pulp, beef, and rice grain with sales values

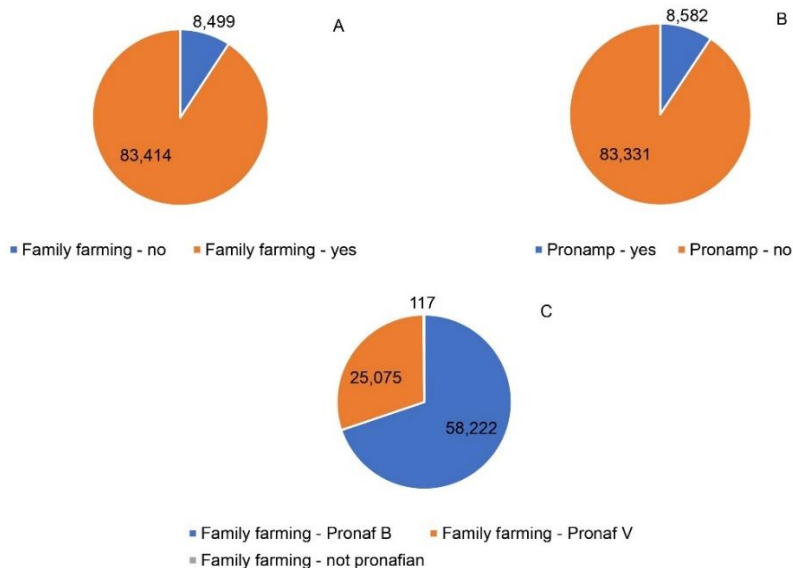


Figure 3. Profile of rural producers with activities in the rural agroindustry in the State of Pará, Brazil. Type of producer (A), access to PRONAMP (B) and access to PRONAF (C).

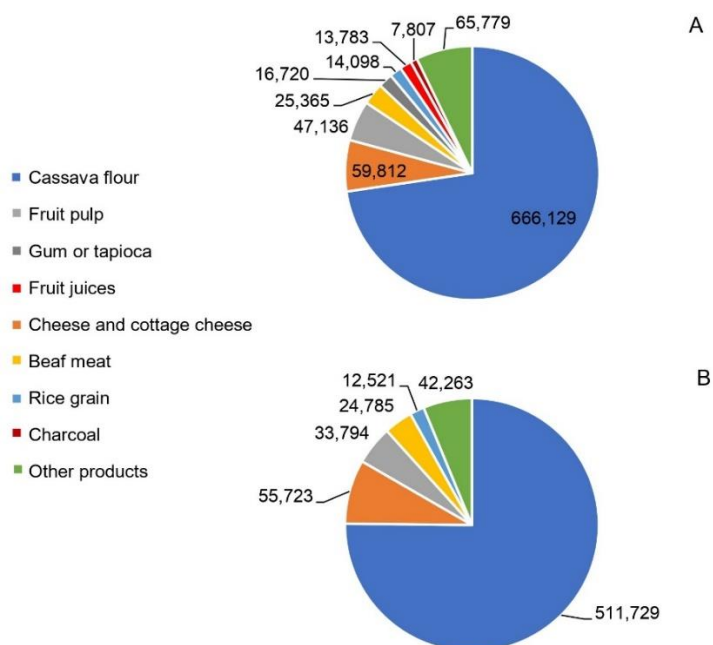


Figure 4. Production value (A) and sales value (B) of rural agroindustry products (thousand reais) in the State of Pará, Brazil.

of R\$ 511,729,000 (US\$ 90,993,604); R\$ 55,723,000 (US\$ 9,908,441); R\$ 33,794,000 (US\$ 6,009,114); R\$ 24,785,000 (US\$ 4,407,170); and R\$ 12,521,000 (US\$ 2,226,434), respectively. Furthermore, other rural agro-industry products achieved a total sales value of R\$ 42,263,000 (US\$ 7,515,038) (Figure 4B).

Production output and sales volume

The Table 1 presents the quantities of production and sales for various rural agro-industry products in the state of Pará, Brazil. Notably, products in terms of production quantity include manioc flour, charcoal, and rice, with 263,728 tons, 15,500 tons, and 12,461 tons respectively. Similarly, the products that stand out in terms of sales quantity are cassava flour, charcoal, and rice grain, with 203,320 tons, 12,662 tons, and 11,551 tons respectively. Additionally, other significant products in both production and sales quantities include cheese and cottage cheese, fruit pulp, gum or tapioca, beef, and fruit juices.

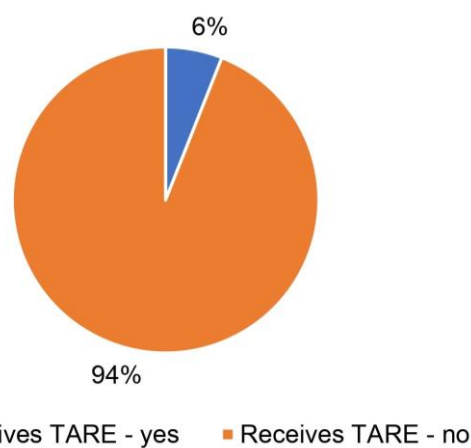


Figure 5. Number of producers with access to Technical Assistance and Rural Extension (ATER) services in the state of Pará, Brazil.

Table 1. Quantities of production and sales of various rural agro-industry products in the state of Pará, Brazil.

Quantity produced			Quantity sold		
Cassava flour	263,728	Mg	Cassava flour	203,320	Mg
Charcoal	15,500	Mg	Charcoal	12,662	Mg
Rice grain	12,461	Mg	Rice grain	11,551	Mg
Other products	8,666	Mg	Cheese and cottage cheese	5,935	Mg
Fruit pulp	7,290	Mg	Fruit pulp	5,162	Mg
Cheese and cottage cheese	6,351	Mg	Other products	4,413	Mg
Gum or tapioca	5,406	Mg	Gum or tapioca	3,139	Mg
Corn meal	3,372	Mg	Beef meat	2,532	Mg
Fruit juices	2,848	L (x 1,000)	Fruit juices	679	L (x 1,000)
Beef meat	2,589	Mg	Leathers and skins	602	Mg
Liqueurs	1,672	L (x 1,000)	Wood products	317	m ³ (x 1,000)
Molasses	1,363	L (x 1,000)	Sweets and jellies	274	Mg
Leathers and skins	602	Mg	Sausages	231	Mg
Wood products	379	m ³ (x 1,000)	Vegetable oils	218	L (x 1,000)
Sweets and jellies	282	Mg	Meat from other animals	146	Mg
Sausages	231	Mg	Pig meat	75	Mg
Vegetable oils	229	L (x 1,000)	Vegetables (processed)	33	Mg
Meat from other animals	148	Mg	Breads, cakes and cookies	31	Mg
Pig meat	83	Mg	Rapadura	24	Mg
Breads, cakes and cookies	68	Mg	Smoke in roll or rope	23	Mg
Sugarcane spirit	44	L (x 1,000)	Molasses	18	L (x 1,000)
Smoke in roll or rope	35	Mg	Liqueurs	14	L (x 1,000)
Vegetables (processed)	33	Mg	Butter	10	Mg
Rapadura	25	Mg	Sugarcane spirit	7	L (x 1,000)
Butter	10	Mg	Sour cream	5	Mg
Treated meat (sun-dried, salted)	8	Mg	Treated meat (sun-dried, salted)	3	Mg
Sour cream	6	Mg	Corn meal	2	Mg
Roasted coffee beans	5	Mg	Roasted coffee beans	1	Mg
Roasted and ground coffee	3	Mg	Cotton down	0	Mg
Cotton down	0	Mg	Cottonseed	0	Mg
Cottonseed	0	Mg	Roasted and ground coffee	0	Mg
Cajuina	0	L (x 1,000)	Cajuina	0	L (x 1,000)
Grape wine	0	L (x 1,000)	Grape wine	0	L (x 1,000)

Mg - Megagram; L - Liters; m³ - cubic meter.

Access to the ATER service, classification according to the origin of the ATER and the groups of activities

The 2017 Agricultural Census sampled 2,699 producers in the state of Pará. From the data analyzed, it was found that 94% (around 264,830 rural producers) do not have access to the ATER service (Figure 5).

Within the subset of producers in Pará who have access to Technical Assistance and Rural Extension (ATER), constituting approximately 6% of the total (around 16,869 producers), an analysis was conducted based on the source of technical guidance they received. The findings revealed that among these rural producers, 52% receive technical assistance from federal, state, or municipal government entities, 30% from the producers themselves, 7% from cooperatives, 4% from integrating companies, 2% from private planning firms, 2% from non-governmental organizations (NGOs), 1% from the S system, and 7% from other institutions (Figure 6).

In the analysis of rural activities, it was observed that among producers without Technical Assistance and Rural Extension (ATER) in Pará (sampled at 281,699 establishments), 34% are engaged in temporary crop production, 32% in livestock and other animal husbandry, and 16% in permanent crop cultivation (Figure 7A). Conversely, for producers with ATER (16,869 establishments), approximately 49% are involved in livestock and other animal husbandry, 24% in temporary crop production, and 15% in permanent crop cultivation. Livestock farming plays a significant role in Pará's economy, with a notable shift in some regions towards rotational grazing practices and genetic improvement initiatives. This transition is attributed to specific

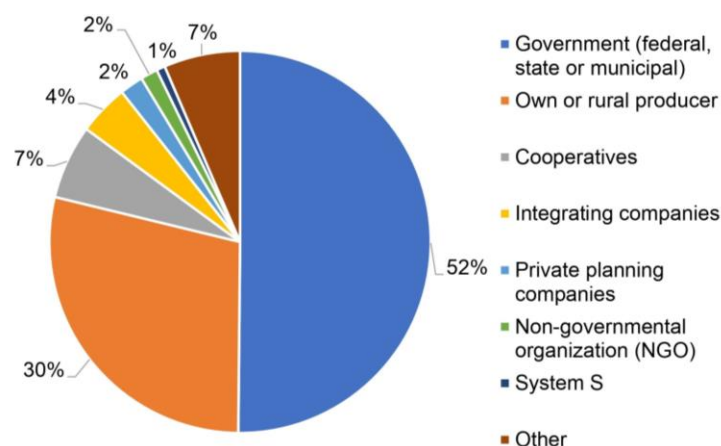


Figure 6. Classification of Technical Assistance and Rural Extension (ATER) according to the origin of the technical guidance received.

government ATER programs for the sector and the involvement of private ATER entities in certain areas of the state (Figure 7B). In Pará, beef cattle farming is predominantly an extensive activity with low productivity. While dairy production is considered a practically family activity, which plays an important role in generating jobs and income, without a technical business vision and without receiving Technical Assistance and Rural Extension (ATER), producers often do not adopt technologies related to animal feed and genetic and health

Table 2. Variables of the rural agro-industry panorama obtained through the 2017 Agricultural Census of the State of Pará.

Variables	Category
Rural property and production data	Number of agricultural establishments with rural agroindustry Quantity produced in rural agroindustry Quantity sold of rural agroindustry products Production value in rural agroindustry Sale value of rural agroindustry products
Profile of farmers	Family farming - no Family farming - yes Family farming - Pronaf B Family farming - Pronaf V Non-Pronafian family farming Pronamp - yes Pronamp - no
Agroindustry products	Cassava flour Charcoal Rice grain Cheese and cottage cheese Fruit pulp Gum or tapioca Beef meat Fruit juices Leathers and skins Wood products Sweets and jellies Sausages Vegetable oils Meat from other animals Pig meat Vegetables (processed) Breads, cakes and cookies Rapadura Smoke in roll or rope Molasses Liqueurs Butter Sugarcane spirit Sour cream Treated meat (sun-dried, salted) Corn meal Roasted coffee beans Cotton down Cottonseed Roasted and ground coffee Cajuina Grape wine

Table 3. Variables of the landscape of technical assistance and rural extension obtained through the 2017 Agricultural Census of the State of Pará.

Variables	Category
Source of technical guidance received	Receives, Government (federal, state or municipal), Own or producer's own, Cooperatives, integrating companies, Private planning companies, non-governmental organization (NGO), System S, Other, does not receive.
Production value classes	Greater than 0 and less than 5,000, From 5,000 to less than 10,000, From 10,000 to less than 25,000, From 25,000 to less than 50,000, From 50,000 to less than 100,000, From 100,000 to less than 500,000, From 500,000 and more, No production value.
Economic activity groups	Production of temporary crops, Horticulture and floriculture, Production of permanent crops, Production of certified seeds and seedlings, Livestock and other animal husbandry, Forestry production - planted forests, Forestry production - native forests, Fishing, Aquaculture.
Typology	Family farming - no, Family farming - yes, Family farming - Pronaf B, Family farming - Pronaf V, Family farming - no Pronaf year, Pronamp - yes, Pronamp - no.

improvement. This results in low utilization by the industries (Láu, 2006; Souza et al., 2018).

Income classification

Within the establishments benefiting from Technical Assistance and Rural Extension (ATER) (16,869 establishments), the primary

income categories for rural producers are the R\$ 10,000 (US\$ 1,778) to R\$ 25,000 (US\$ 4,445) range (20%), followed by the R\$ 0.00 (US\$ 0.00) to R\$ 5,000 (US\$ 889) range (17%), and the R\$ 25,000 (US\$ 4,445) to R\$ 50,000 (US\$ 8,891) range (14%) (Figure 8A). In contrast, among establishments without ATER (264,830 establishments), the main income categories for rural producers

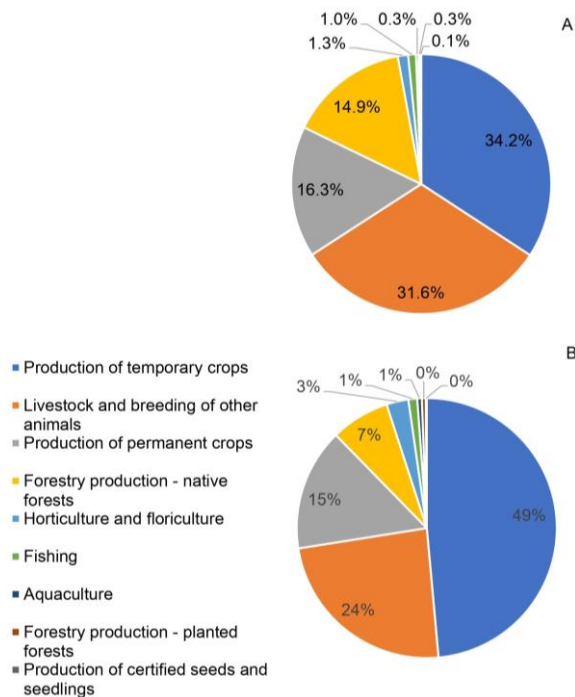


Figure 7. Classificação dos produtores rurais que não recebem (A) e que recebem Assistência Técnica e Extensão Rural (ATER) (B) quanto ao grupo de atividades rurais desenvolvidas.

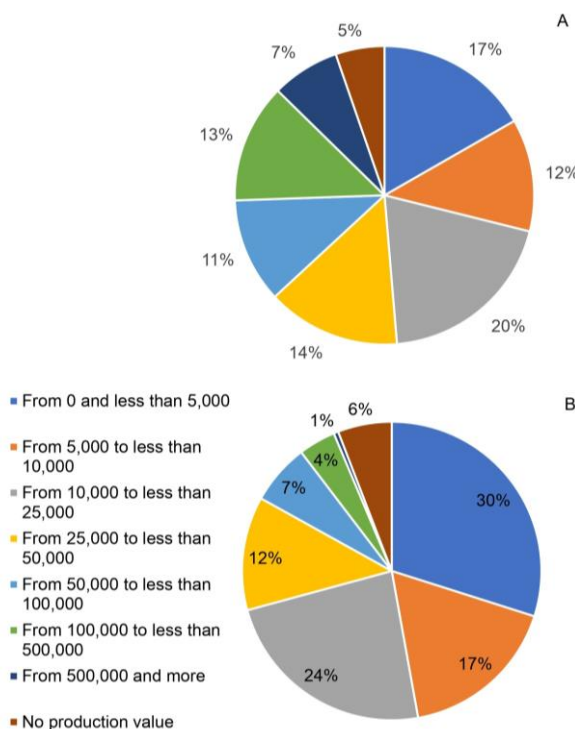


Figure 8. Classification of rural producers who do not receive (A) and who receive Technical Assistance and Rural Extension (ATER) (B) in terms of their income from rural activities.

are the R\$ 0.00 (US\$ 0.00) to R\$ 5,000 (US\$ 889) bracket (30%), followed by the R\$ 10,000 (US\$ 1,778) to R\$ 25,000 (US\$ 4,445) bracket (24%), and the R\$ 5,000 (US\$ 889) to R\$ 10,000 (US\$ 1,778) bracket (17%) (Figure 8B).

The use of Technical Assistance and Rural Extension (ATER) results in a significant increase in farmers' income, indicating the effectiveness of ATER as an income generation tool. The expansion of this policy, coupled with systematic analyses for constant improvement, is a promising path for the economic development of family agriculture in Brazil (Rocha Junior et al., 2020).

Typology of rural producers

In the state of Pará, the typology of rural producers receiving Technical Assistance and Rural Extension (ATER) revealed that 3,151 were categorized as non-family farmers (18%) and 14,510 as family farmers (82%), with a total of 17,661 sampled producers (Figure 9A). Among the family farmers, 8,516 (58.7%) accessed the Pronaf B credit line, 5,915 (40.8%) utilized the Pronaf V credit line, and 79 (0.5%) were non-Pronaf beneficiaries (Figure 9B). Regarding PRONAMP, 3,080 producers (17%) were identified as beneficiaries of this program, while 14,581 (83%) were not participants (Figure 9C).

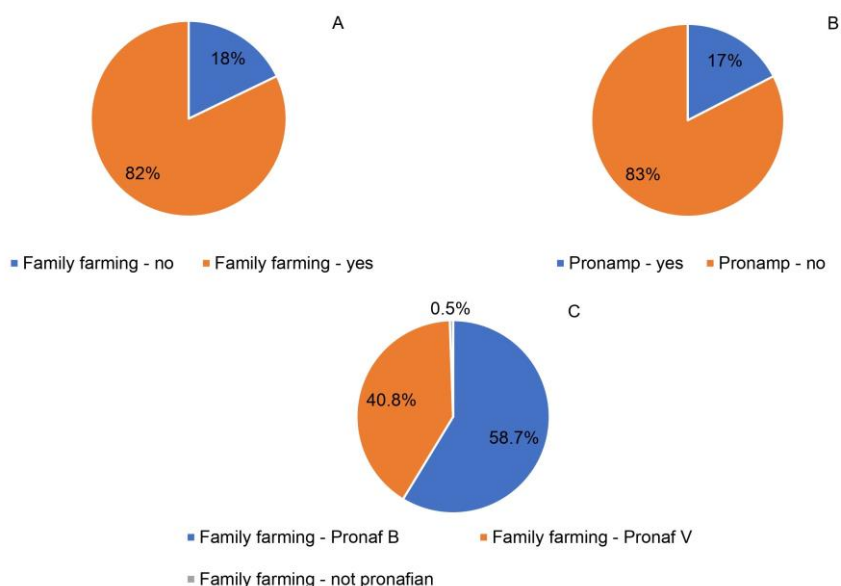


Figure 9. Profile of rural producers receiving Technical Assistance and Rural Extension (ATER) in the state of Pará, Brazil. Type of producer (A), access to PRONAMP (B) and access to PRONAF (C).

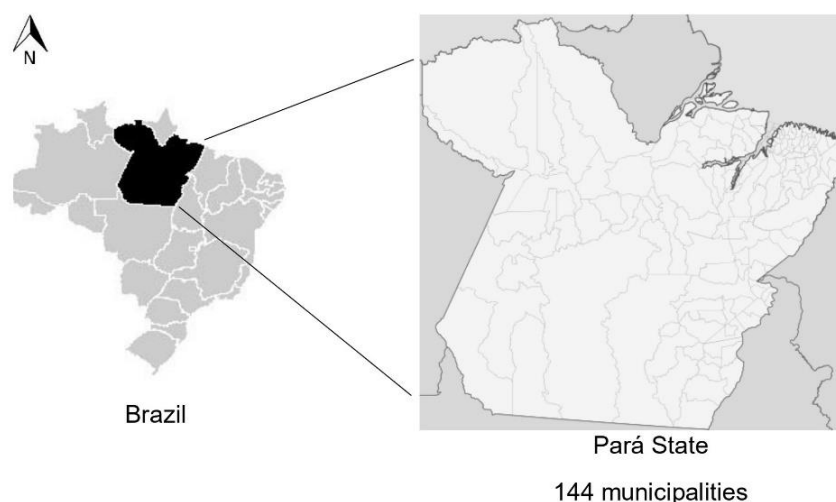


Figure 10. Map of the Brazilian state of Pará and its 144 municipalities.

Materials and methods

Rural agro-industry database

This study used data extracted from the 2017 Agricultural Census conducted by the Brazilian Institute of Geography and Statistics (IBGE, 2017a), obtained through the IBGE Automatic Recovery System (SIDRA) (IBGE, 2017b). To investigate the rural agro-industrial landscape, the research focused on identifying agricultural establishments engaged in rural agro-industrial activities in Pará, Brazil (Figure 10). Parameters examined included the nature of these establishments, the characteristics of rural producers, production and sales volumes of rural agro-industrial goods, as well as the corresponding production and sales values (Table 2).

The production of rural agro-industry was defined as the output of agricultural establishments that experienced processing or transformation within their own premises, community facilities, or external facilities. This process involved utilizing raw materials sourced from the establishment itself or obtained from other producers. The final destination of the product was determined by the rural producer, aligning with the criteria outlined in the 2017 Agricultural Census (IBGE, 2017a).

ATER service database

To collect data on the landscape of technical assistance and rural extension, the study examined the sources of technical guidance received in Pará, Brazil. Data extracted from the 2017 Agricultural Census conducted by the Brazilian Institute of Geography and Statistics (IBGE, 2017a), obtained through the IBGE Automatic Recovery System (SIDRA) (IBGE, 2017b) were used. This investigation encompassed categorizing the guidance based on production value classes, economic activity groups, and the typology of rural producers (Table 3).

Data analysis

Descriptive statistics were used to analyze the acquired data. The data was converted into percentage values to make comparisons easier. Pie charts were created to visually represent the proportions of different categories. Tables were also made using Microsoft Excel to organize the data clearly and allow for detailed examination.

Conclusions

The analysis of data extracted from the 2017 Agricultural Census in Pará enabled a comprehensive examination of the local rural agribusiness landscape and the provision of technical assistance and rural extension services. The census revealed a total of 105,921 establishments engaged in rural agribusiness, predominantly with land areas not exceeding 50 hectares. The demographic profile of rural producers indicated a prevalence of family farmers who have access to programs like PRONAF and PRONAMP. Prominent rural agro-industry products in terms of both production and sales value included manioc flour, cheese, fruit pulp, beef, and rice grain. Additionally, cassava flour, charcoal, and rice grain were notable for their significant quantities produced and sold. Access to Technical Assistance and Rural Extension (ATER) in Pará remains limited, reaching only 4% of agricultural establishments. Those rural producers benefiting from ATER services tend to belong to higher income brackets compared to those without access. Non-ATER beneficiaries are primarily engaged in temporary crop activities, followed by livestock and permanent crops. In contrast, ATER recipients are predominantly livestock farmers, with secondary involvement in temporary and permanent crop cultivation. The majority of producers surveyed in the 2017 Agricultural Census are family farmers, with a significant proportion having access to PRONAF credit lines and a smaller percentage benefiting from PRONAMP initiatives.

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