

THE VALUE OF COST MANAGEMENT FOR THE FAMILY FARMER IN SOYBEAN PRODUCTION

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ABSTRACT

This study highlights the relevance of cost management for family farmers who produce soybeans. To this end, we sought to analyze the cost management of soybean production in a family farm in Vale do Ivinhema (MS). Methodologically, the present research is characterized as qualitative with descriptive nature, case study with field research, application of interview and content analysis. The theoretical foundation is based on the literature on agribusiness, the soybean agro-industrial complex, family farming and cost management. To collect the data, semi-structured interviews were used and information was collected from producers regarding the agricultural production of the 2022/2023 soybean harvest. The family has been running the property for more than 60 years, however among the 3 children only one continued in the agricultural segment. The level of education among the interviewees presents an educational contrast, contributing to an analysis of different generations in the management of soybean production. Production costs are currently managed by the son, who closely monitors the price of inputs. In the 22/23 soybean harvest, a deficit result was found due to difficulties in following the financial market and the need for liquidity in times of low commodity prices. The result presented in a theoretical way contributes to previous studies, by discussing the complexity of family farm management, the importance of continuous adaptation and the balance between experience and technical knowledge to face the challenges in an agricultural scenario in constant evolution.

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INTRODUCTION

The terminology known to all as agribusiness is understood as an interdependent compound of productive activities and distribution of agricultural supplies, production activities in the field, storage, processing (transformation) and the distribution of production to the market (Soares; Jacometti, 2015). From the basic links (production of inputs, agricultural activity, processing and distribution) contained in a production chain linked to some agribusiness product, the existence of several support services for activities such as: agricultural research, port activities, technical assistance, transportation services and others (Silva; Lake; Brandalise, 2018).

Brazil's agricultural scenario has developed exponentially in the last 40 years and is currently a crucial vector of the country's economic growth. Given that in 2022 the Gross Domestic Product (GDP) generated by the sector reached 24.8%, corresponding to approximately 1/4 of the Brazilian GDP (CEPEA, 2023).

The large scale of production in Brazil is due to several aspects such as climatic variations, new technologies on the rise, the demanding consumer market, the increase in exports that makes it the second largest exporter today. However, when it comes to soybeans, Brazil is the largest producer and exporter, occupying 50% of world trade (EMBRAPA, 2022). These aspects have driven the sector to produce more and with greater efficiency. The competitiveness of the agricultural sector makes Brazil take the world lead, with emphasis on soybeans in the present study.

According to the Confederation of Agriculture and Livestock of Brazil (CNA, 2021), soybeans (grains) are the flagship of Brazilian agriculture, approximately responsible for R\$1.00 of every R\$3.55 of the sector's production in Brazil. Soybeans, due to their relevance in the Brazilian economic scenario, provide the states with the largest production chain with prominence in their relevance, an example of which is Mato Grosso do Sul. The state has always stood out for its agricultural potential since its creation in 1977, as it is located in fertile territory, which currently occupies the 5th place in the national ranking of grain production (FAMASUL, 2021). With an estimated growth of 41.7% compared to the previous season, the 2022/2023 soybean harvest in Mato Grosso do Sul exceeds 12.3 million tons (FAMASUL 2022).

The expressive production results are due to technological changes in agriculture and, as a result, it is possible to observe their effects, providing improvements, development and evolution to the sector. It is also notorious a high concentration of costs

to acquire these new technologies such as machinery, equipment, inputs and pesticides, in order to provide improvements in production results.

In this context, cost management is essential to provide income generation to family farmers, because in Brazil, according to the last IBGE agricultural census, in 2017, 77% of rural establishments are family owned (Brasil, 2019). Cost management is a tool to measure, subsidize, plan and control the activities developed in the rural environment, adding not only quantitative but also qualitative value to the property, through well-structured and reliable information.

Crepaldi (2019) states that in search of stricter economic and financial control, the need for qualified professionals and labor is extremely important for carrying out rural activities in production itself and in administrative areas. The task of generating management information that enables decisions based on consistent and authentic data has been a difficulty for rural producers. Business managers need to know where and how they are using their resources and what financial returns they are getting. Martins (2018) emphasizes that cost accounting has three relevant and contributing roles in this process: assisting planning, control, and helping in decision-making.

In view of the facts presented, this article aims to answer the following research question: What is the importance of cost management for the family farmer who produces soybeans? The objective of this study is to analyze the cost management of soybean production in a family farm in Vale do Ivinhema (MS).

This research is relevant because the situation of family farming has changed over the years. It is necessary to demystify the belief that the family farmer basically seeks subsistence, and for this it is necessary to develop, adapt to changes and choose to survive in the face of increasingly fierce competition. Farmers must be aware of the way they make their decisions and need to identify strategies to organize their production process, in order to add value to their products and maximize market insertion.

THEORETICAL FRAMEWORK

AGRIBUSINESS AND SOYBEAN AGRO-INDUSTRIAL COMPLEX

Agribusiness is understood as a collaborative system between producers, suppliers, inputs, equipment, government, and others. As it is a complex and broad field, agents need to adopt a management vision to know and understand all aspects that involve their business, seeking better results in a globalized world (Oliveira *et al.*, 2018). Mendonça

(2015) understands that the term agribusiness in Brazil is used to justify the creation of production chains, with the objective of adding agrochemical, industrial and commercial activities to the economic calculation of agriculture.

The soybean production chain stands out in the Brazilian economy because Brazil is among the world's main producers and exporters of this grain. According to projections, the country remains in the lead, accounting for more than a third of world production (EMBRAPA, 2022). The year 1901 was a milestone for the introduction of soybeans in Brazil, with the beginning of cultivation at the Campinas Agricultural Station and the distribution of seeds to farmers in São Paulo. Grains began to be easier to find in the country after the intensification of Japanese migration in 1908 (APROSOJA, 2013). Soybean cultivation is a milestone in the process of Brazilian agro-industrial development, its influence is so profound that it is possible to divide this process into two phases: before (subsistence agriculture) and after soybeans (corporate agriculture). The establishment of soybeans in Brazil was an important factor in economic and social development (Dall'agnol, 2016).

Soybean agricultural production has three significant stages, known as planting, maintenance and harvesting. Planting takes place through seeds that must be thrown into properly prepared soils, then fertilization is carried out, which like planting happens with the help of machines and labor. In the maintenance stage, the necessary treatments for the plant take place, where pests and diseases are fought through fungicides, insecticides and the like. The last stage, known as harvesting, is the final operation, where it can be carried out in a mechanized way, with the use of harvesting machines and the support of employees (Araújo, 2010). Soybeans are composed of proteins (40%), oil (20%), cellulose (17%), sugars (7%), ash (6%), fiber (5%) and others (5%) (Federizzi, 2012). Protein gives rise to edible products such as pasta, meat products, cereals, prepared mixes, beverages, baby food, dietary products, and animal feed. Whole soybeans are used by the food industry in general and crude oil is transformed into refined oil and lecithin which, in turn, gives rise to several other products. It is also used in the clothing industry, the adhesives and nutrients industry, fertilizers, foam formulators, fiber manufacturing, coating, paper, water emulsion for paints, the fuel sector, nutritional compounds and in several other industrial segments (Federizzi, 2012).

The soybean complex is an example of an *agricultural commodity*, in its definition *commodities* are goods that have not yet been processed, that is, raw materials. In the

financial market, they indicate agricultural and mineral products. Because they are sold in large quantities, and for several countries in the world they have stock exchanges dedicated to the trade of *commodities* (BOVESPA, 2017). In this context, it is necessary to understand that the formation of prices of agricultural commodities is not carried out by producers, but rather by price takers (Alves, 1998). With the market defining the value to be traded, price instability also brings additional costs to the participants of these markets, both producers and consumers. Price fluctuations cause increased risks for producers, generating higher management costs, which can alter decisions between hedging and investing (Gardebroek; Hernandez, 2013; Wu; Guan; Myers, 2011).

Therefore, the relevance of the soybean commodity in the context of Brazilian agribusiness is understood, this is the country's main export product and cooperates strongly with the positive balance of trade. Its price volatility in the market and production risks are the biggest risk factors for the rural producer.

FAMILY FARMING

Family farming encompasses any family-based agricultural activity and is linked to several areas of rural development, consisting of a means of organizing production managed and operated by a family and being in both developed and developing countries the predominant form of agriculture in the food production sector (FAO/UN, 2014). Until the mid-1990s, family farming in Brazil was known under different expressions, such as: mini landowners, small producers, subsistence farmers, low-income farmers, among others. The economic activity of these producers has almost always been called small production (Navarro, 2010).

In Brazil, the geography of family farming contains a diversity of regional contexts, sheltering an uneven social universe that encompasses both small farmers from southern Brazil, heirs of the "colonial polyculture" of European migrants in the nineteenth century, and riverside dwellers from the Amazon river environment to those located in the northeastern agreste, historically located in the vicinity of sugarcane monoculture (IBGE, 2011).

Law No. 11,326, of July 24, 2006, contains the definition that establishes the concepts, principles and instruments for the formulation of public policies aimed at family farming. A family farmer is considered to be a producer who works in a rural area, whose area does not exceed four fiscal modules, with a predominance of family labor, with a

minimum percentage of family income coming from the activities of his establishment and managed jointly with the family (BRASIL, 2006). According to Berchin *et al.* (2019), family farming, together with large-scale agriculture, is essential for Brazilian food security. Investing in public policies to encourage permanence in the countryside is extremely necessary, given that these farmers provide food for local businesses and schools. Family farming needs to achieve economic balance, but it is necessary to have financial control and awareness of the reach of financial resources, maintenance of its establishment and inputs for production (Kraychete, 2007). Cruz *et al.* (2020, p.2) point out that "it is not enough just to provide credit to the family producer, if he does not have the necessary technical knowledge to improve his production".

Support for agricultural family production can be a strategy for boosting the economy of many Brazilian municipalities and with great potential for reducing social inequality and poverty in territories with strong rural characteristics that are going through a phase of economic stagnation. Nevertheless, some challenges still persist for the consolidation of such a strategy, such as: deficient infrastructure for production logistics, need for processing and commercialization, and low level of formal education of farmers (Silva, 2011).

The Agricultural Census carried out in 2017 verified more than 5 million rural properties in Brazil, showing that 77% of the country's agricultural establishments were classified as family farming. In terms of area, family farming occupied 80.9 million hectares in the period surveyed, corresponding to 23% of the total area of the Brazilian agricultural establishment. According to the survey, in September 2017, more than 10 million people were employed in family farming, accounting for 67% of total employment in agriculture. Family farming also accounts for 23% of the total value of production of agricultural establishments (BRASIL, 2019).

It is pointed out that the performance of family production is essential for the economic development and supply of Brazil, the permanence of the producer in the field adds value to the regions with the highest concentration of production. Family farming has its importance observed worldwide and goes by various nomenclatures and in different regional contexts.

COST MANAGEMENT

Derived from financial accounting and management accounting, cost accounting had its beginnings in the Industrial Revolution. From that moment on, organizations began to buy raw materials to transform them into products (Schier, 2013). For Martins (2018), the emergence of cost accounting was driven by the need for more accurate control and identification of the values acquired during the production process.

Cost accounting was developed to fulfill a specific purpose related to providing data to measure profit, profitability, and equity valuation. This practice consists of identifying, recording, accumulating and organizing the different elements related to the operational activities of the business and has the function of providing management with data representative of the amount of resources used to carry out the various stages of its operational processes (Callado, 2011). From these concepts, it is possible to understand the role of costs in an organization in a broad way, however, when applied to the rural sector, Crepaldi (2019) recognizes the organizational and structural limitations imposed on rural entrepreneurs, highlighting that it has been difficult for them to generate managerial information that enables decision-making based on consistent and reliable data. Therefore, the relevance of cost management in the agribusiness environment is understood as a control factor, which needs to be constantly evolving, in order to assist in the economic and social development of family farming (Ederer, 2015).

To carry out cost management efficiently, it is necessary to understand that the way of attributing costing methods in companies is closely linked to the way costs are allocated, it involves the determination of costs and results of a costing object through ordered processes, and it is essential to observe the unique characteristics of each method (Souza; Borinelli, 2012). The classification of costs can happen in different ways: as to the form of appropriation to the product (Direct or Indirect); as to the volume of production (Fixed or Variable); as to the registration value; as to the form of accumulation and as to the object of funding (Souza; Clemente, 2011).

Megliorini (2011) proposes that the first step to calculate costs is the segregation of expenses that occurred in the period, pointed out as costs, expenses and investments. For the second step, it is necessary to distinguish between direct and indirect costs. The correct distribution and classification of costs is of paramount importance because it will be allocated following the costing method to be used. There are several costing methods

presented in the literature, among which the following can be highlighted: absorption costing, variable costing, activity-based costing and RKW (Scanferla, 2015).

According to Andrade *et al.* (2012), the absorption costing method appropriates all production costs, whether fixed or variable, direct or indirect, to the products produced in a given period. For Martins (2018), absorption costing is the method where its application is in accordance with the generally accepted Accounting Principles. It consists of the appropriation of all production costs to the manufactured goods, and only the production costs, all expenses related to the production effort are distributed to all the products or services made. In Brazil, Absorption Costing is included in Technical Pronouncement CPC 16, of the Accounting Pronouncements Committee (CPC), which deals with the valuation of inventories, in items 12 to 14 (Martins, 2018).

Regarding variable costing, it arose from the need to mitigate distortions in relation to the criteria for apportioning fixed costs in existing costing methods (Oliveira, 2018). The variable costing method is considered the most appropriate for the company's control and decision-making, because in it the profit moves with the same proportion of the sales volume, allowing better information on the performance of the entity's products, facilitating the calculation of the contribution margin, break-even point, safety margin and profitability, relevant information for the decision-making process (Megliorine, 2011). Variable costing should be used only for management analysis, as the legislation imposes the application of absorption costing for accounting and tax purposes. In this methodology, variable expenses are attributed to the product and fixed costs are considered as expenses in the result.

METHOD

The author Gil (2007) defines research as a rational and systematic procedure, whose objective is to provide answers to the problems that are proposed. In order to achieve the objective of analyzing the cost management of soybean production in a family farm, the present research is characterized as qualitative with a descriptive nature. Qualitative research, according to Minayo (2010), provides the construction and/or revision of new approaches, concepts and categories regarding the studied phenomenon of a society, with respect for the existing diversity. Qualitative research focuses on the individual and their relationships and interactions with the environment.

For data collection, the research technique used was the application of semi-structured interviews, as it combines open and closed questions, where the informant has

the possibility to discuss the proposed theme. The researcher must follow a set of previously defined questions, but he does so in a context very similar to that of an informal conversation (Boni; Quaresma, 2005). The data were complemented by documents provided by the producer, and the objective was to identify the information regarding the notion of costs, profitability of production and formation of the sale price of soybeans on a family property. The research was carried out in a specific environment, characterized as a case study that, according to Yin (2010), this research method is used in various situations, contributing to the knowledge of individual, group, organizational, social, political and related phenomena.

After data collection, the content obtained was analyzed, as Bardin (2011) understands, content analysis aims to analyze what was said in the midst of an investigation, building and presenting conceptions around an object of study. The analysis of the collected material follows a rigorous process in view of the phases defined by: Pre-analysis; Exploration of the material and treatment of the results. The semi-structured interview with the family farmer took place in September 2023, the data obtained went through these described procedures and after that, they were filtered, analyzed and transcribed for the present research.

PRESENTATION AND ANALYSIS OF RESULTS

GETTING TO KNOW THE PROPERTY

Soybeans are considered one of the most relevant products in the economy of the state of Mato Grosso do Sul, and production is increased by the participation of families benefiting from the National Program for the Strengthening of Family Agriculture (PRONAF). The present research was conducted in a rural property located in the municipality of Taquarussú (MS), the participants were father and son who reported the form of administration they use to control their costs during soybean production. Chart 1 presents the data of the interviewed producers.

Table 1: Characteristics of producers

Interviewee	Age	Sex	Schooling	Experience Tempo Not Segment
1	73 years	Men.	Fourth year primary	60+ years
2	30 years	Men.	Graduated in agronomy	20+ years

Source: Survey data.

The family has been running the property for more than 60 years, however among the 3 children only one continued in the agricultural segment. The level of education among the interviewees presents an educational contrast, highlighting not only the individual evolution, but also the transformation of the sector. The combination of the father's practical experience, acquired since childhood, and the son's technical knowledge contributes to an analysis of different generations in the management of soybean production. The two are the main drivers of production, the other participants are day laborers who help at certain times of production such as planting and harvesting, but not constantly.

The study does not point to the occurrence of farmers without schooling, in this perspective Breitenbach (2014) highlights the importance of studies in rural areas, as the farmer's education can be a factor that can boost the growth and development of the rural establishment. It is inferred that the lack of study of rural property managers may be one of the reasons why these establishments do not develop in several aspects, such as technology, new forms of production, as well as in property management, directly impacting cost management.

COMPOSITION OF PRODUCTION COSTS

When producers were asked what costs and expenses are part of production, the costs shown in Chart 2 were identified.

Table 2: Production costs and expenses

Direct costs	Charges, direct labor, seeds, fertilizers, leasing, fertilizer and chemical pesticides.
Overhead	Indirect labor, machine maintenance, depreciation.
Expenditure	Bank loans, financial expenses (interest), insurance, electricity, water, Telephone/Internet, Certification (annual fee expenses)

Source: Survey data (2023)

After knowing which costs make up the production, the producer was asked how he organizes the beginning of his production, in order to understand the first disbursements, organized in Chart 3.

Table 3: Steps before making the first disbursements:

1st Definition of the size of the area that will be occupied in production;
2nd Quotation of inputs for planted area, in order to observe the values, distributors and brands;
3rd Cost entries in excel spreadsheets or notes;
4th Dilution of costs distributed per alqueiro

Source: Survey data (2023)

Regarding the understanding related to the moment when disbursements occur, it was reported that planting is the stage of production that occurs the highest disbursement, with land use being the highest cost and bank interest classified as the highest expense. Calgaro and Faccin (2012) report that the diagnosis of production problems can be made through the analysis of the composition of production costs, allowing to determine and identify which cultivation process will occur with the most significant expenses.

Production costs are currently managed by his son, who closely monitors the price of inputs, because according to him it is a crucial moment for production. By exploring different sales locations, it seeks to identify the best value for money, avoiding exclusive dependence on a specific supplier. His training in agronomy provides knowledge of alternatives in situations of high prices, allowing substitutions for products with the same active ingredient, performing the same function, but at a lower cost.

COST MANAGEMENT

The management of the property is shared by the family, which is done privately, and it is not possible to identify a costing method. After this finding, the producer was asked about his view in relation to professionals in the cost area and their importance for production. His answer was as follows:

In family farming, which is our case, it is not managed with the professionalism of a large businessman, a producer with business scales already has a person responsible only for managing costs there. In family farming it does not reach this level of precision, it is much simpler, because since it is a smaller area to control it is easier. But it is understood that the professional is relevant, but not working effectively, but perhaps as a consultant. Because if for the producer to pay this person monthly, annually, with CLT contracts the cost would go up and the account would not close due to a small area to dilute this cost.

Scaln, Maia and Maia (2019) explain that family farming has different dynamics and characteristics compared to non-family farming, corroborating Hansen and Mowen's (2012) understanding that cost management is the tool able to produce information for internal users. Specifically, cost management identifies, collects, measures, classifies, and brings information that is useful to managers for costing (determining how much something costs), planning, control, and decision-making. The son, when asked about the importance of data collection for production, replied as follows:

Fundamentally, they guide the level of investment I can have if the cost of implementing the crop is higher than it has always been, I have to make replacements, I have to sometimes reduce the amount of fertilizer mainly to lower the cost of production and the accounts close.

Next, it was discussed how the money is managed before starting the harvest, the producer makes it clear that to direct investments it is necessary to adapt to variations in the cost of implementing the harvest. Flexibility during the process is crucial, considering factors such as weather conditions and pest incidence. The spending decision is dynamic, avoiding rigidity in planning and adjusting to seasonal demands.

The production data are analyzed weekly, the periodicity reflects the need for continuous monitoring to optimize resources, especially during the period between harvests, where area maintenance and other adjustments occur. The treatment of production data is conducted through Excel spreadsheets, reflecting a practical and effective approach. While some producers opt for charts, the simplicity of the spreadsheet meets the needs of the producer, recording costs, expenses, and revenues in an organized way.

The purchasing decision-making process was also reported, which is influenced by factors such as the choice of soybean varieties, where the additional cost for biotechnology, known as *royalties*, is incorporated into the value of the seed. The selection of the variety for the crop is usually based on previous experiences. On the other hand, sales decisions are often linked to the maturity of inputs, reflecting the need for liquidity to meet financial obligations, even when the price of the *commodity* is not favorable, highlighting the importance of hedging strategies. Financing and payment of inputs are decided based on the difference between cash and installment payment, considering commercial conditions and the impact on expenses when choosing between bank financing and direct payment to the supplier.

If the concepts of contribution margin and break-even point, outlined by Dubois, Kulpa and Souza (2019) and Martins (2018), are widely used for management, the authors explain the importance of covering fixed costs and expenses to ensure profitability. Although producers are not familiar with these terminologies, they apply these principles to determine selling prices and achieve profitability. Understanding these financial aspects is crucial to ensure economic sustainability in production. Reflecting the producer's understanding of the financial aspects of production, continuous evaluation of these parameters is vital to ensure economic sustainability. Also questioned about the notion of

depreciation of his assets, although knowledge of this concept is recognized, the practice of calculation is limited, especially considering inflation and market variations. The real complexity of depreciation for, with the example of the property's tractor that at the time of purchase cost one hundred and twenty thousand reais in 2019 and today after several economic factors such as high inflation is valued at three hundred thousand, highlights the need to consider external factors in asset management.

SALES PRICE FORMATION

After identifying the main expenses resulting from production, the interviewee was asked about the sale price practiced by him in the production of soybeans on his property.

Today soybeans are one hundred and twenty reais, then the producer thinks I pay my production cost and there is something left, I have to sell it at one hundred and twenty-five. When those hundred and twenty-five arrive, go there and make the sale. In general, the only thing the producer can achieve is this. It is to reach a sale value that he wants. Because in the formation of the price we cannot interfere in anything, what we work on is a commodity. So its price is influenced by all the variables of the planet, escaping our jurisdiction.

The negotiation of the 22/23 soybean harvest was done after the harvest, the producers never used the futures contract strategy to sell soybeans with a price already defined, however in this production according to the son they were at a loss. At the time of planting, the bag was one hundred and seventy reais, and because it was not following the financial market, they left it to make the sale after the harvest as usual, finding at the time of sale a value of one hundred and twenty-one reais. At the conclusion of this report, the producer highlighted: "I had a great financial loss with this. And because of that I am monitoring the financial market and we are going to start selling in advance, to lock in a value that covers my costs."

After harvesting, the soybeans are sold through a cooperative, in which two and a half percent of each bag is allocated for its maintenance. When asked about the choice of soybeans among other options such as horticulture or agriculture, the producer realizes the complexity of horticultural production, emphasizing the significant demand for labor. Family farming is often limited in terms of land extension, challenges arise when children seek opportunities outside the property. Although horticulture is more profitable than soybeans in his view, the preference for the latter is common due to the lower need for labor, reflecting the producer's view that "the greater the risk, the greater the possibility of return" in agriculture.

FINAL CONSIDERATIONS

The research objective related to the importance of cost management for the family farmer soybean producer was ascertained and discussed directly. From analysis with a qualitative approach carried out through interview and subsequent analysis, it is understood that the objective was achieved.

In a theoretical way, the research contributes to previous studies, making evident the relevance of the combination of practical experience and technical knowledge in the management of a family farm. The contrasting educational evolution among members reflects not only individual trajectories but also transformations in the agricultural sector. Cost management, currently conducted by his son with a degree in agronomy, stands out for the constant search for efficiency and flexibility in the face of seasonal and climatic variations. The weekly analysis of production data, carried out in a practical way through spreadsheets, exemplifies an adaptive and effective approach. Decision-making in the purchase and sale of inputs reveals the importance of previous experience and consideration of factors such as royalties and commercial conditions. The intuitive application of financial concepts, such as contribution margin and break-even point, emphasizes the search for economic sustainability in production.

However, the lack of monitoring of the financial market resulted in losses in the last harvest, highlighting the need for constant evaluation of the strategies adopted. The limitation in the practice of depreciation calculation highlights challenges in asset management, especially in the face of volatile economic factors. In short, this study highlights not only the complexity of family farm management, but also the importance of continuous adaptation and the balance between experience and technical knowledge to meet the challenges in an ever-evolving agricultural landscape.

The main limitations of this study refer to the approach of only one property, and there can be no generalization to the object of the subjects addressed. It is relevant to understand the existing reality for the rural producer with regard to cost management and price formation, but the analysis may still need further studies with a longer period of time, crop diversity and comparison between properties. As a research agenda, it is important to carry out quantitative studies in the area, as well as crop diversification.

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