Programa de Pós-Graduação Desenvolvimento Regional mestrado e doutorado

DOI: 10.17058/redes.v29i1.19027

Driving regional development: an analysis of the decision making process and innovation in rice agribusinesses

Alvaro Neuenfeldt Júnior
Universidade Federal de Santa Maria – Santa Maria – RS – Brazil
ORCID: https://orcid.org/0000-0002-6492-6342

Andressa Rocha Lhamby
Universidade Federal de Santa Maria – Santa Maria – RS – Brazil
ORCID: https://orcid.org/0000-0003-0516-0110

Abstract
The rice agro industry performs an important role in regional development, facing constant challenges in terms of competitiveness and innovation. The aim of this study is to propose integrated strategies for improving managerial decision making in agro industries in the rice sector. The study explored key factors such as productivity and infrastructural, financial and socio-economic aspects. Using a qualitative and quantitative methodological approach, the study combines a literature review, benchmarking visits to three rice agribusinesses of different sizes and the application of an instrument using a Likert scale to identify operational practices and challenges. The results indicate a significant correlation between these factors and effectiveness in the decision-making process, highlighting the importance of strategic management for innovation and development in the sector. In addition, they suggest the need for efficient decision-making approaches aligned with market demands, highlighting paths to sustainability and economic growth in the context of the rice sector, which facilitates the promotion of regional development.
Keywords: Rice agroindustry. Regional development. Competitively. Innovation. Decision making.

Impulsando El desarrollo regional: un análisis del proceso de toma de decisiones e innovación en agroindustrias arroceras

Resumen
La agroindustria arrocera juega un papel importante en el desarrollo regional, enfrentando constantes desafíos de competitividad e innovación. El objetivo de este estudio es proponer estrategias integradas para el perfeccionamiento de la toma de decisiones gerenciales en las agroindustrias del sector arrocero. El estudio exploró factores clave como la productividad, factores infraestructurales, financieros y socioeconómicos. Utilizando un enfoque metodológico cual-cuantitativo, el estudio combina una revisión de literatura, visitas de benchmarking a tres agroindustrias arroceras de diferentes tamaños y la aplicación de un instrumento que utilizó la escala Likert para identificar prácticas y desafíos operacionales. Los resultados indican una correlación significativa entre estos factores y la eficacia en el proceso de toma de decisiones, destacando la importancia de la

gestión estratégica para la innovación y desarrollo en el sector. Además, sugieren la necesidad de enfoques de toma de decisiones eficientes y alineados con las demandas del mercado, resaltando caminos hacia la sostenibilidad y el crecimiento económico en el contexto del sector arrocero, facilitando la promoción del desarrollo regional.
Palabras clave: Agroindustria Arrocera. Desarrollo Regional. Competitividad. Innovación. Toma de Decisiones.

1 Introduction

The concept of agribusiness is derived from the English expression agribusiness, which covers the business of the farming sector and its relations. It involves everything from the manufacture of inputs for agricultural production, handling, the cultivation process, harvesting, equipment, implements, pesticides, fertilizers, technology, storage activities, processing, industrialization, distribution and consumption, such as the refrigerators, supermarkets, food distributors and their relations with the market. Agribusiness is the result of all the operations involved in the manufacture and distribution of agricultural inputs, on-farm production operations and the storage, processing and distribution of agricultural products (Bajan; Mrówczyńska-Kamińska, 2020).

In terms of agribusiness, it is interesting to emphasize its importance in shaping local GDP: coffee, rice, wheat, soybeans and corn make the country a leading international producer, along with the production of oilseeds, meat and fruit (MAPA, 2020). It is well known that rice is the second most cultivated cereal worldwide, occupying an area of approximately 163 million hectares and showing good production potential. In particular, rice is the staple food for more than 3 billion people worldwide, which has major repercussions on social, economic and environmental aspects. It is a healthy and complete food due to its nutritional characteristics, rich in complex carbohydrates and fiber and, consequently, aids in the treatment of diabetes mellitus. It is also an intestinal regulator, does not contain gluten and is therefore important for people with celiac disease (IRGA, 2019).

In this context, the food guide for the Brazilian population recommends the consumption of fresh or minimally processed foods, such as rice, as the basis for a nutritionally balanced, tasty, culturally appropriate diet that promotes a socially and environmentally sustainable food system (Ministry of Health, 2014). However, the oscillations in the price of rice on the global market end up having undesirable impacts. Therefore, the new strategies could be implemented, precisely in order to add value to the products offered to customers. It also stimulates the local economy, generating jobs and income for rice-growing regions.

According to IRGA (2019), the search for competitively can lead the organizations to reduce production costs and add value to the product. The rice is a cereal with limited processing processes for products intended for human consumption. However, the processing process generates by-products such as broken grain and the raw material for producing rice flour, which has the potential to develop products that cater for specific niches due to its lack of gluten, a fundamental characteristic for celiac.

In this way, there are opportunities to develop new products and processes that could ensure greater competitiveness for companies that produce and use rice

flour, spreading the consumption of products beyond the niche market and contributing to regional development, since the organizations will attract wealth to the regions where they operate. These opportunities could be alternatives for increasing rice consumption, moving the entire production chain (IRGA, 2019).

According to Yin (2014), the differentiation refers to the level of exploitation of products and services, as the companies that stand out differentiate their products from competitors, making imitation more difficult. The central idea of differentiation is to provide the end customer with products of superior quality, and the investments in research and development, quality, standards, inputs, technology and personnel management are among the factors that affect product quality. The perspective on organizational development consists of a contradictory process, with reflexes in the forms of accumulation and organization of production and in society, and its complexity is not considered when based on positive analyses based on a fragmented and one-dimensional view (Fontoura; Tenório; Allebrandt, 2023).

Considering the importance of agro-industries for agribusiness, especially for the rice sector, their capacity to generate rural and regional development is undeniable. Adopting strategies that value differentiated products can open up new markets, benefiting producers and communities. These strategies contribute to the diversification of production and the sustainability of production chains, performing a fundamental role in preserving family farming. By implementing innovative and sustainable practices, rice agribusinesses not only strengthen their competitiveness, but also promote development in the regions where they are located, positively impacting the local economy and the communities' quality of life (Silva; Gazolla, 2021).

Therefore, the aim of this research is to propose integrated strategies for improving managerial decision-making in agribusinesses in the rice sector. The research design seeks to explore strategies that go beyond competitiveness and innovation in the rice sector, with a focus to strengthening and advancing socio-economics from the perspective of sustainable regional development.

2 The decision making process in the rice sector

At the end of the 1970s, the first practical and utilitarian decision making model was developed, focusing on the information processing method and the problem solving proposal. This model was based on the assumption that leaders should have all the decision making styles and use them in different situations, but at the time, the system was unable to cope with the complexity that these activities require (Remenova; Jankelova, 2019).

From this perspective, the decision making process can impact both the consumer and the agro-industry or manager/farmer. Nadja *et al*. (2021) characterize the consumer decision making process as follows: discovery of needs, search for information, evaluation of alternatives, decision making and post purchase behavior.

When it comes to agribusiness, according to Gargouri, Hammadi and Borne (2002), the competitive advantage of this industry consists of dealing with constant market changes. So, it is necessary to think strongly about integrated management and decision making processes. These must be computerized and new production

control systems must be developed that are not generic, but rather with the particularities of the production systems of the agro food and rice industries.

Today, a growing number of companies that have used six sigma processes to improve performance, including reducing operating costs, increasing customer satisfaction, reducing cycle times and increasing profits. However, regardless of the nature of the improvement, all projects follow the "Define-Measure-Analyze-Improve-Control" methodology and aim to optimize processes (Versiani *et al*., 2021).

In this segment, a company's strategic orientation involves four main patterns of behavior: regeneration, organizational rejuvenation, strategic renewal and domain redefinition. Sustained regeneration behaviors exploit untapped market opportunities, either by introducing new products, or current products in new markets, or some combination of the two. Organizational rejuvenation behaviors, on the other hand, involve improving an organization's competitiveness by enhancing its internal processes, structures and/or abilities. In strategic terms, the key is to bring about a fundamental change in the way a company competes, in other words, a company can, in some cases, completely reposition a generic strategy from differentiation to leadership (Gilinsky; Newton; Eyler, 2018).

According to Aktas and Demirel (2021), sustainability assessment in companies should facilitate investors in the decision making process on sustainable strategies. Different methodologies based on Hybrid Multi-Criteria Decision Making (MCDM) have been systematized to help companies assess if they are doing their economic, environmental and social objectives. The decision making models can be fully customized according to the needs of the organization. Peña-González *et al.* (2021) developed a mathematical model to optimize planning decisions in Colombian oil palm, which considers different products, types of warehouses, modes of transport and export options, reflecting, as much as possible, on the current situation of the industry. It also establishes as free variables the location of storage facilities and production, their expansion possibilities and the flows of all the raw materials and end products involved. It is a quantitative tool to support the decision making in the area of biomass based strategic design and optimal planning.

In the case of decision making methods available in the literature, MCDM stands out, since methods can be categorized based on different purposes, with some pros and cons for each method (Khedrigharibvand *et al*., 2019).

Coteur *et al*. (2016) report on the experience of a framework that was developed interactively through discussions with researchers and managers, as well as consultation with experts and advisors from the five sectors, ensuring in depth validation. The purpose was to develop a tool to support farmers who consciously choose to evaluate their farms and thus improve their processes.

In terms of the social, economic, infrastructural and institutional factors that affect the decision-making process of farmers, Swami and Parthasarathy (2020) report that the price of a commodity is affected by market interventions at a national or international level. These key factors move the consumption and expenditure of each individual, which in turn affects the market economy, influencing demand and supply. In addition, different adaptation options were categorized in the adaptive strategies, taking into farmers' perceptions.

According to Fontoura and Tenório (2020), organizational development is perceived as a broad concept that includes all the dimensions of business development at its various scales, with a critical focus and oriented towards

regional development. This concept, which was explored in detail by Warren Bennis, is characterized by changes in organizations that cover values, attitudes and internal relations as well as the decision making process. Fontoura and Tenório (2020) point out that Bennis identified that the challenges facing organizations are grouped into categories, including issues of growth and organizational identity, development, satisfaction and organizational efficiency.

Besides emphasize the importance of organizational change strategies that build on existing behaviors to develop new patterns, following a "paradigm effect". In addition, there is a tendency towards limited collaboration between the change agent (the consultant) and the members of the organization (the clients), which can be an obstacle to the success of change initiatives. Change agents, according to this view, share a social philosophy that includes socio-environmental concerns, which reflects the complexity and multifacility of organizational development in the context of regional growth and socio economic progress.

With regard to increasing sales/production/consumption through the end consumer's decision making process, Nadja *et al.* (2021) point out that, in their experience, the process began with the consumer's awareness of a problem or a daily need. They tend to choose between what they need and what they want. There are several steps for consumers to take in order to be fully aware of their needs, such as why they buy a particular rice product and the benefits of consuming it.

In addition, the evaluation of alternatives is one of the stages of the purchasing decision making process, describing the beliefs and attitudes of consumers that influence consumer decisions. In this process, the consumer will carry out an evaluation which is one of the main stages of consideration before the final decision is made.

Nowadays, information resources that enable the digitization of technological processes and areas of activity are widespread as aids in the decision making and innovation process. Among the strategies used is an information system, which is a set of interconnected personnel management tools, methods and strategies used to store, process and issue information that is essential for management development.

The digital platform is an integrated information system that guarantees a reduction in transaction costs, optimization of business processes and growth in the distribution of agricultural products in the "field (farm) - consumer" system. The platform makes it possible to remotely control the quantity and quality of the product at any stage of movement in the "field (farm) consumer" system.

In this way, it is possible to establish interaction between companies and industries in the food sub complex and federal executive organs. A large amount of information for analytical, planning and forecasting activities will make it possible to solve the problems that impede the development of agricultural production in the country in a timely manner (Zhevora; Tulcheev; Borisov, 2021).

Therefore, the partnership between the public sector, academic institutions, cooperatives, associations and market participants facilitates the promotion of regional development in rural territories. As pointed out by Deponti *et al.* (2022), not only satisfying local socio economic requirements, but also promoting a better economy and facilitating job creation by stimulating more profitable productive activities. Specifically, in the context of the rice sector, this integrated strategy

increases the significant potential to contribute to sustainable and inclusive development, highlighting the relevance of adapting and applying collaborative management and production models. By adopting such models, the rice sector performs a crucial role in advancing the economic and social development of rural regions, in line with the objectives of sustainable and fair regional development.

3 Methodological approach

This study adopted a qualitative and quantitative methodological approach in order to understand the dynamics of decision making in the rice sector and its impact on regional development. The integration of a literature review with benchmarking visits and quantitative analysis of questionnaires made it possible to understand the practices and operational challenges encountered by rice agribusinesses. The methodology was carefully structured into distinct stages, with each one performing a crucial role in the collection and analysis of relevant data. The selection of the sample, the definition of the key factors, the development of the research instrument, the collection and analysis of the data were carried out following rigorous procedures in order to ensure the representativeness and accuracy of the information collected. Table 1 summarizes the main stages of the research and the methodological approach used.

Table 1 - Research stages

Research stage	Detailed Description
Definition of Approach	Mixed qualitative and quantitative methodological approach, combining literature review and benchmarking visits for qualitative identification of practices and challenges, followed by quantitative analysis of questionnaires.
Sample selection	The invitation was open to all 41 ABIARROZ member companies, with a voluntary response from 20 agribusinesses, providing a diverse and representative sample of the sector.
Defining Key Factors	Identification of the key factors (productivity, social, infrastructural, economic and environmental factors) that influence decision making in rice agribusinesses, based on relevant scientific articles. This stage provided insights into trends, challenges and successful practices in agribusiness, essential for understanding the dynamics of the sector. Essential references, which range from Fleskens, Duarte and Eicher (2009) to Peña-González *et al.* (2021), set a solid foundation for the research.
Drawing up the instrument	Development of a survey instrument structured into six categories, which reflect the key factors defined above. This instrument was carefully designed to capture the complexity of management practices in rice agribusinesses, allowing for an in depth analysis of the areas of interest identified during the literature review phase and benchmarking visits.
Data collection	Use of a Likert scale for the answers to the questionnaire, which makes it easier to express the participants' level of agreement or disagreement with the proposed statements.
Data Analysis	Grouping variables by key factor and applying Spearman's correlation test (1904) and simple linear regression, with a significance level of $p \leq 0.05$, to explore relations between variables and influences on key factors.

Source: Made by the authors (2023).

The qualitative and quantitative methodological approach used combined a literature review and benchmarking visits to three rice agribusinesses of different sizes to identify operational practices and challenges (qualitatively), in order to

design the research instrument (Gariba Júnior, 2018) and then base its quantitative analysis. The process of selecting the agribusinesses involved an open invitation to all 41 companies associated with the Brazilian Rice Industry Association (ABIARROZ) (2023). Of this group, 20 agribusinesses responded voluntarily, which represents a diverse and representative sample of the sector. The unintentional choice of these companies contributes to the authenticity and impartiality of the data collected, reflecting a realistic panorama of decision making practices in the rice growing context.

By defining the key factors (productivity, social, infrastructural, economic and environmental factors) based on the scientific articles verified in the literature review - in particular the articles by Fleskens, Duarte and Eicher (2009), Leal and Flores (2013), Bitzer and Ndou (2016), Coteur *et al.* (2016), Morel and Léger (2016), Reck and Schultz (2016), Gilinsky, Newton and Eyler (2018), Margolis *et al.* (2018), Chousou and Mattas (2019), Gardas *et al.* (2019), Duan, Wibowo and Chong (2021), Lizot, Trojan and Afonso (2021) and Peña-González *et al.* (2021) – provided an overview of trends, challenges and successful practices in agribusiness, as well as helping to understand the dynamics that influence decision making in agribusinesses.

The survey instrument used the indicators defined in the literature review: socio-demographic, productivity, social, infrastructural/environmental, economic and operational data. So, the survey instrument is structured into six categories:

a) Category 1: Questions related to socio demographic data indicators (to understand aspects of the workforce and identify the size of the organization);
b) Category 2: Questions related to productivity indicators (with the aim of finding out about the organization's productivity, analyzing time management, automation, organizational structure, management control practices, quality and reliability of the inputs and production control);
c) Category 3: Questions related to social factor indicators (to assess the organization's commitment to ethics, economic and regional development, improving the quality of life for its workforce, their families and the community in general);
d) Category 4: Questions related to infrastructural and environmental factor indicators (try to understand environmental issues, especially environmental regulations, sustainability, waste management and renewable energy);
e) Category 5: Questions related to economic factor indicators (analyze economic factors and their impact on the organization's conduct);
f) Category 6: Questions related to operational factor indicators (knowing how the organization plans, executes and monitors all processes to ensure effective decision making and actions that generate real results).

For data collection purposes, it was decided to provide alternative answers to the questions in categories 2 to 6 using the Likert scale as a reference, as this is a systematic approach that makes it easier for respondents to express their level of

agreement or disagreement with a series of statements, which contributes to the analysis of attitudes or collective perceptions and makes it possible to interpret trends and patterns in the data collected (Ho, 2017). The answers vary according to a 5-value scale for the level of agreement (totally disagree -1, partially disagree -2, neither agree nor disagree -3, partially agree -4 and totally agree -5).

In addition, the key factors were broken down into indicators to simplify the analysis, making it easier to quantify the key factors that influence decision making in the rice sector. For example, grouping together indicators related to productivity gives a clear picture of how this aspect is being managed and what its main influencers are. Similarly, indicators under the sociodemographic factor provide a characterization of the profile of the managers who are the survey respondents.

The statistical analysis carried out in this study used the reasoning of grouping by factor, these being the key factors that influence decision making and which were obtained through the study and the literature review conducted (productivity, social, infrastructural, economic and environmental factors). Each key factor was made up of six indicators and so they remained grouped together.

The data was analyzed using inferential statistics to verify the association between the variables, using Spearman's correlation test (1904) and simple linear regression, adopting a significance level of $p \leq 0.05$. As a result, we used the reasoning of grouping each of the indicators (each key factor was the grouping of the six questions used in the instrument, each question was an indicator, so each factor (F) was the sum of six indicators referring to the same theme) into scores providing a deeper understanding of the associations between the indicators and their interrelations. The score was based on the sum of the answers provided by each of the agribusinesses (totally disagree -1, partially disagree -2, neither agree nor disagree -3, partially agree -4 and totally agree -5).

Through the scoresheet, correlation and simple linear regression were applied to group variables into key factors to extract complex information into manageable components. According to Santos and Pinto (2018), simple linear regression is a way of estimating a model. This process makes it easier to identify and quantify the relations between variables, reducing the multidimensionality of the data without reducing the integrity of the information.

By grouping variables, in this case indicators, by key factors, it is possible to simplify the data structure, facilitating interpretation and allowing for a more efficient regression analysis that is less susceptible to problems such as multicollinearity. There is multicollinearity in a multiple regression model when two or more independent variables are strongly linearly related to each other (Maia, 2017). However, the use of correlation and regression in derived factors can reveal results about the hypotheses that influence the phenomena studied, offering a deeper understanding and a more realistic model for evidence based decision making. They are a set of statistical techniques used to demonstrate relations between variables and determine the value of one or more variables (Maroco, 2003).

The analysis of the data collected focused on interpreting these quantitative responses, trying to identify significant correlations between the key factors and regional development. This approach showed how different challenges, as well as the practices and strategies adopted by the agro industries - aspects identified through the responses to the questionnaire – there is a direct impact on the

economic and social dynamics of the regions where they are located. So, the results of this study provide support for the development of strategies aimed at strengthening the competitiveness and innovation of rice agribusinesses, contributing significantly to sustainable regional development.

Using the scoresheet, correlation and simple linear regression were applied to group variables into key factors in order to extract complex information into manageable components. According to Santos and Pinto (2018), simple linear regression is a way of estimating a model. This process makes it easier to identify and quantify the relations between variables, reducing the multidimensionality of the data without decreasing the integrity of the information.

4 Key factors that influence the decision making process in the rice sector

This section presents the results obtained from the statistical analysis done, demonstrating the significant interrelationships between the various key factors in the context of rice agribusinesses. Table 2 shows the "p" values for the key factors analyzed by correlation. The research identified many significant correlations among various key factors in the rice sector, with the purpose of understanding how different aspects of agribusiness management are interconnected. Initially, it was observed that productivity is correlated with infrastructural, financial, social and socio economic factors. This suggests that improvements in any of these domains can have a positive impact on productivity, highlighting the importance of a holistic approach to effective management.

Table 2 - p-values

KEY FACTORS	p-value
Productivity and infrastructure factors	p=0.02
Productivity and financial factors	p<0.01
Productivity and social factors	p<0.01
Productivity and socioeconomic factors	p<0.01
Social factors and financial factors	p=0.01
Social and socioeconomic factors	p=0.04
Infrastructural factors and socioeconomic factors	p<0.01
Infrastructural and financial factors	p=0.02
Socioeconomic and financial factors	p<0.01

Source: Made by the authors (2023).

Besides, the research revealed a notable correlation between the social and financial aspects of agribusinesses (p=0.01). This indicates that social initiatives within agribusinesses not only benefit the community and workers, but can also have a positive financial impact. Similarly, the correlation between social and socioeconomic factors (p=0.04) emphasizes how social issues are interlinked with the wider economic environment in which agribusinesses operate.

The correlations between infrastructure and socioeconomic factors, as well as between infrastructure and financial factors, were also identified as significant. This emphasizes the importance of infrastructure not only in terms of daily operations, but also in its role in economic and social development.

Also, the relationship between socioeconomic and financial factors emphasizes the interdependence between the economic health of agribusinesses and the socioeconomic context in which they operate. This understanding reinforces the need for strategies that consider both economic and socioeconomic aspects in order to achieve sustainable success in the sector.

In this way, the results of the study demonstrate the complexity and interconnection of the factors that influence the decision making process in rice agribusinesses, emphasizing the need for an integrated vision to improve efficiency, sustainability and socioeconomic impact in the sector.

Analyzing productivity and infrastructural factors, p=0.02 and a correlation coefficient of 0.50 were obtained (Table 3), indicating a moderate and statistically significant positive correlation between productivity and infrastructural factors. This suggests that improvements in infrastructure may be associated with increases in productivity.

Table 3 - Correlations between key factors

KEY FACTORS	1	2	3	4	5	6
1. Number of employees	1	0,5	0,15	0,14	0,02	0,18
2. Productivity	-	1	0,60*	0,50*	0,58*	0,72*
3. Social factors	-	-	1	0,42	0,46*	0,53*
4. Infrastructural factors	-	-	-	1	0,58*	0,51*
5. Socioeconomic factors	-	-	-	-	1	0,79*
6. Financial factors	-	-	-	-	-	1

*$p<0.05$

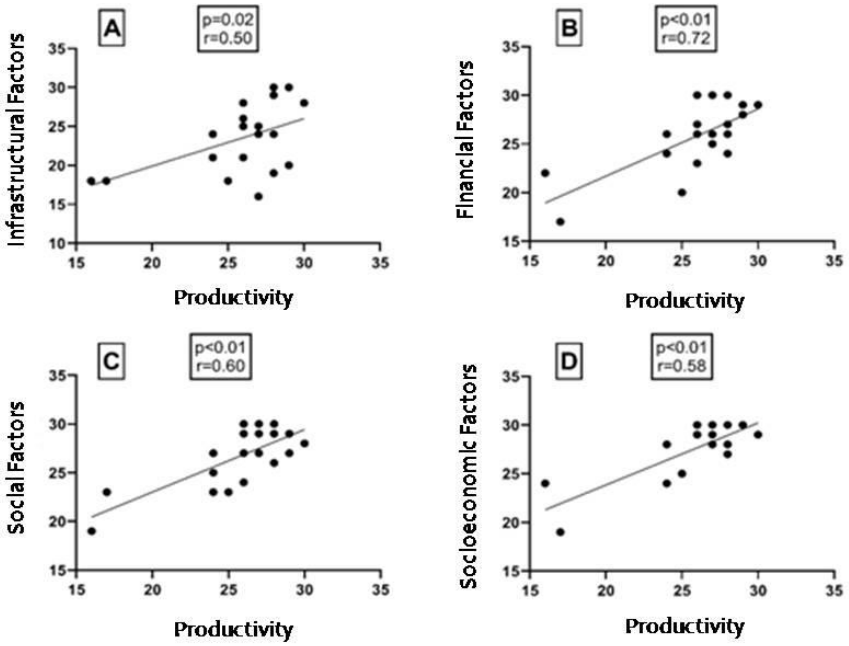
Source: Made by the authors (2024).

Figure 1 shows the results of the correlation between productivity and infrastructural factors (Figure 1A), financial factors (Figure 1B), social factors (Figure 1C) and socio economic factors (Figure 1D) for all the agribusinesses evaluated.

From the linear regression, it was identified that productivity influenced social factors by 58% ($r^2=0.586$, $p<0.01$). This suggests that more productive organizations can have a significant impact on quality of life and social wellbeing in the region. The 25% influence ($r^2=0.255$, $p=0.02$) on infrastructural factors indicates that productivity also affects infrastructure, but to a lower degree. The high influence of productivity on social factors includes better working conditions, the creation of more jobs and improvements in community services.

It was also verified that productivity influenced socio-economic factors by 61% ($r^2=0.611$, $p<0.01$); it can therefore be seen that productive efficiency is important for economic growth and regional development. The higher the workers' income, the better their standard of living and access to resources. Productivity also had a 51% influence ($r^2=0.519$, $p<0.01$) on financial factors: it directly affects the financial health of agribusinesses, facilitating greater investment, innovation and competitively.

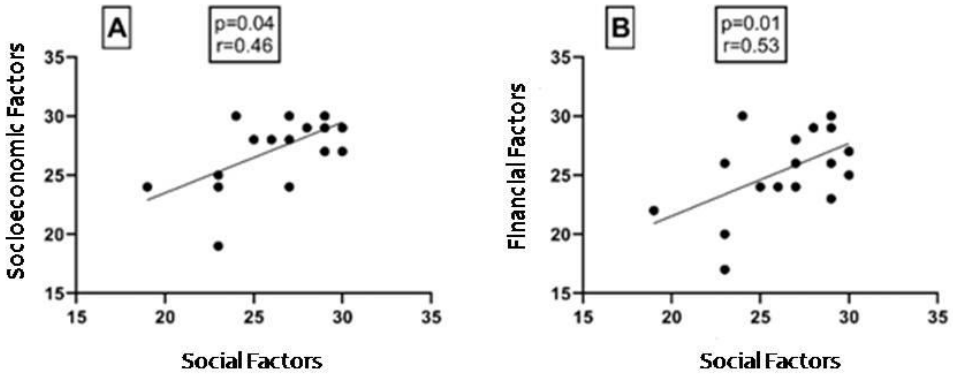
Figure 1 - Graphical representation of the correlation between productivity and infrastructural, financial, social and socioeconomic factors



Source: Made by the authors (2024).

Figure 2 shows the results of the correlation among social factors and socio economic factors (Figure 2A) and financial factors (Figure 2B) for all the agribusinesses evaluated. From the linear regression, it was identified that social factors influenced socio-economic factors by 37% (r^2=0.378, p<0.01), which shows that the 37.8% variation in socio-economic factors can be explained by the variation in social factors. This suggests that improvements in social factors, such as working conditions, health and education, have a moderate impact on the socio economic development of the region. Social factors also had a 29% influence (r^2=0.290, p=0.01) on financial factors, which indicates a moderate influence of social factors on financial health and sustainability in agribusinesses. Better social aspects lead to a more productive and pleasant working environment, which can positively influence the profitability and financial stability of organizations.

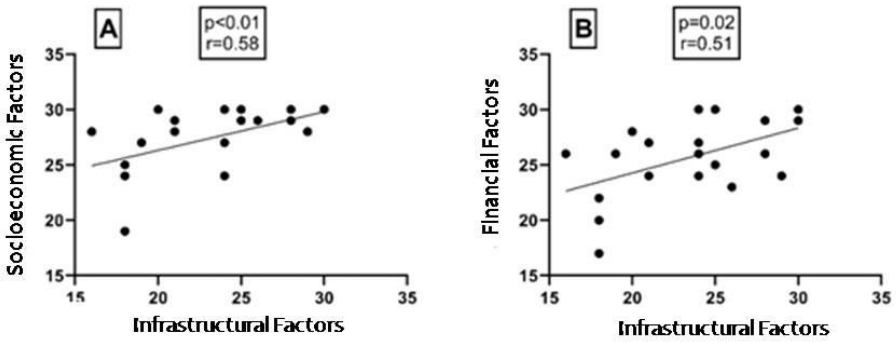
Figure 2 - Graphical representation of the correlation between social factors and socio-economic and financial factors



Source: Made by the authors (2024).

Figure 3 shows the results of the correlation among infrastructural factors and socio economic factors (Figure 3A) and financial factors (Figure 3B) for all the agribusinesses evaluated. From the linear regression showed that infrastructure factors influenced socio economic factors by 26% (r^2=0.267, p=0.01). As a result, improvements in infrastructure (such as transportation, communications and energy) can have a positive impact on the socio-economic development of the regions where agribusinesses are located. Similarly, infrastructure factors were found to influence financial factors by 26% (r^2=0.263, p=0.02). This indicates that adequate infrastructure can improve the financial health of agribusinesses, resulting more efficient operations and reducing logistics costs, which improves the profitability and financial sustainability of organizations.

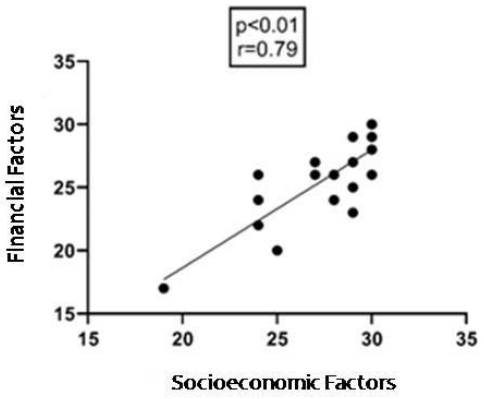
Figure 3 - Graphical representation of the correlation between infrastructural factors and socio economic and financial factors



Source: Made by the authors (2024).

Figure 4 shows the results of the correlation between socio economic factors and financial factors for all the agribusinesses evaluated. From the linear regression, it was found that socio-economic factors influenced financial factors by 63% (r^2=0.635, p<0.01). This suggests that improvements in the socio-economic environment of the regions where agribusinesses are located (including aspects such as education, health, employment and income) have a significant impact on the financial health of these organizations. Therefore, a population with better socio-economic conditions will facilitate the supply of a qualified workforce and increase local purchasing power, providing a more prosperous business environment.

Figure 4 - Graphical representation of the correlation between socioeconomic factors and financial factors

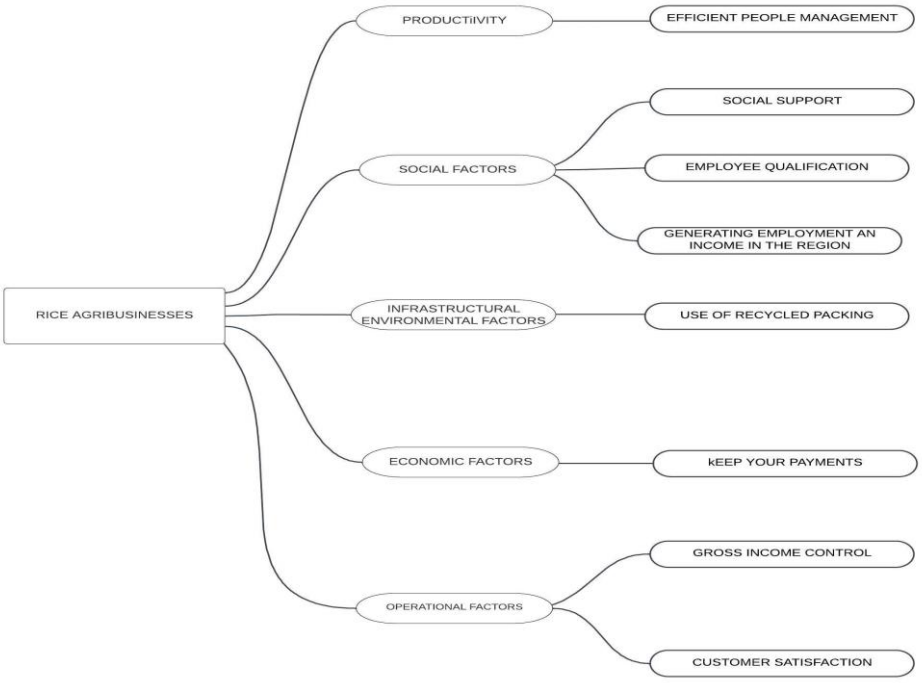


Source: Made by the authors (2024).

The analysis of specific factors through the scores offers a combination of structure, depth and flexibility, allowing for a comprehensive and detailed assessment, but in such a way that all aspects are manageable.

Also, through character importance analysis, the main issues that are relevant to promoting the competitively of agro-industries were identified. The purpose of this analysis is to present the statistical results obtained by the study in a graphic and associative way. Figure 5 shows the analysis conducted in this study.

Figure 5 - Cluster analysis result



Source: Made by the authors (2024).

In the context of the "rice agribusinesses", are emphasized the main factors and sub factors that influence and are influenced in the search for competitively.

The structure of the analysis is divided into five factors (categories 2 to 6 of the research instrument) which are:

a) The "Productivity" factor, which emphasizes the importance of "Efficient People Management" in order to achieve optimized production, suggesting the assignment of people in such a way that their full potential is used, through the division of positions, sectors and tasks into different hierarchical levels, trying to align the company's objectives with those of the employees;
b) The "Social Factors", emphasizing the importance of "Social Support", "Employee Qualification" and "Generating Employment and Income in the Region". These actions are important for the operational success of agribusinesses, but also to ensure that they operate in an ethical and responsible manner, benefiting both the organization and the community in which they operate;
c) The "Infrastructural (Environmental) Factors", in particular the "Use of Recycled Packaging", emphasizing environmental concern. In the process of adopting environmentally correct strategies, such as the use of recycled packaging, agribusinesses demonstrate a commitment to sustainability and environmental responsibility, benefiting not only the environment, but also the organization itself in terms of efficiency and reputation;
d) The "Economic Factors" emphasize the need to "Keep with your Payments". Keeping with financial commitments is fundamental to the

economic and operational health of an agribusiness, facilitating the continuity of operations and establishing a reliable and responsible relation with the market, facilitating future opportunities;

e) The "Operational Factors" deal with "Gross Income Control" and "Customer Satisfaction". These factors ensure that the organization is financially healthy and that it continues to settle or overcome its customers' expectations.

According to Silva and Brisola (2023), in the context of rice agribusinesses, attention to factors such as "Productivity", "Social Factors", "Infrastructural (Environmental) Factors", "Economic Factors" and "Operational Factors" is crucial for promoting competitively and regional development. This study corroborates this view, emphasizing the importance of efficient people management, social aid, the use of recycled packaging, financial responsibility and quality control in the search for operational excellence and contribution to regional socio economic development.

Silva and Brisola (2023) also point out that the agribusinesses' attention to these factors facilitates the decision making process in agribusinesses in the rice sector, as it offers a clear and organized view of the factors and sub factors, making it easier to understand the areas of focus and priorities.

The rice agribusiness is a vital sector for the economic and social development of many regions, especially in rural and agricultural areas. This sector not only provides essential food for the local and global population, but is also an important generator of employment and income. Effective decision making within rice agribusinesses has a direct impact on the growth and sustainability of these companies, thus influencing regional socio economic development. Optimizing decision making processes in agribusinesses can lead to an increase in productivity and efficiency, contributing to greater regional development.

The rice agribusinesses face unique challenges, which vary according to the regional context. These challenges include, but are not limited to, infrastructure issues, access to markets, climate variability and socio environmental pressures. A well founded decision making approach adapted to these specific conditions can help agribusinesses overcome these challenges, promoting sustainable growth that benefits both companies and local communities. For example, informed decisions about sustainable practices can help mitigate negative environmental impacts, while approving the reputation of the agribusiness and promoting regional sustainability.

The decision making practices in rice agribusinesses have the potential to positively influence the socio economic development of the regions where they operate. Strategic decisions that focus on innovation, operational efficiency and social responsibility not only improve the competitively of agribusinesses, but also generate social benefits, such as job creation and improving the quality of life of local communities. For example, investing in technologies that increase productivity can result in better income for farmers and workers, while adopting responsible social practices can improve the image of agribusinesses in the community, reinforcing their position in the regional market.

Studying and classifying the factors through statistical tools, providing a model, has made it easier for agribusinesses to make decisions optimally, directing resources and efforts to critical areas. In addition, this dynamic helps with strategic planning, allowing agribusinesses to identify opportunities and challenges. In addition, the method can be used as a communication tool to present ideas and strategies to stakeholders, teams and partners, and can be complemented with other information relevant to the organization's day by day operations. This analysis will bring benefits to agribusinesses, from production optimization to customer satisfaction.

5 Conclusions

The rice agribusinesses face a series of challenges and opportunities in a constantly evolving environment. It is important to consider multiple factors, from productivity and people management to socio economic and environmental aspects (categories of the survey instrument developed in this study). The suggestions for improvement presented serve as a comprehensive tool to help these industries navigate this complex scenario, providing clear insights into areas of focus and priorities. In addition to the academic contribution, this work has practical and business significance, as it offers insights that may be fundamental to the future of the decision making systems of rice agribusinesses.

The correlation between productivity and the other factors discussed in this study emphasizes the interdependence of these elements in promoting efficiency and competitively. The emphasis on customer satisfaction, compliance with obligations and effective people management reinforces the idea that success in agribusinesses is not only based on operational practices, but also on sustainable and ethical relations with the market in which they operate. Also, the attention paid to sustainability, especially through the use of recycled packaging, reflects a growing awareness of environmental responsibility in agribusiness, especially in the rice production sector.

Therefore, for rice agribusinesses to succeed in a competitive market, a decision making process that is concerned with all these factors is essential. The implementation of the proposed improvements can serve as a guide so that managers know where they need the most attention in order to facilitate the growth of the agribusiness. With the right management system, these companies can identify opportunities, face challenges and achieve their goals in an ethical and sustainable manner.

In general, the significant correlations found in this study suggest that financial management is linked to operational performance and efficiency in expense management. In this way, the decision making process becomes assertive and evidence based, maximizing positive financial results and guaranteeing the company's permanence in the market, as well as sustaining the growth of agribusinesses.

In addition, agribusinesses that promote employee training may have a more balanced financial sector, perhaps because they have more employees who are trained and satisfied with their work, indicating that organizations that emphasize staff training tend to be more successful in monitoring their performance systematically.

The associations analyzed may reflect a commitment to effective management, financial transparency, sustainability and financial performance in organizations, although this does not imply direct causality and may be influenced by factors not measured so far.

It is worth noting that the analysis of rice agribusinesses reveals an interconnection between the management policies of these organizations and the sustainable development of the rural territories in which they operate. The ability of these agribusinesses to incorporate improvements in productivity, people management, socio-economic and environmental responsibility not only increases their own competitive performance and efficiency, but also serves to promote regional development. By adopting strategies that promote sustainability, customer satisfaction and human resource management, rice agribusinesses not only strengthen their position in the market, but also contribute to generating jobs, promoting sustainable agricultural practices and improving the quality of life in local communities.

REFERENCES

AKTAS, N.; DEMIREL, N. A hybrid framework for evaluating corporate sustainability using multi-criteria decision making Environment. **Development and Sustainabilit**y, *[s.l.],* v. 23, p. 15591-15618, 2021. Disponível em: https://orcid.org/ 10.1007/s10668-021-01311-5. Acesso em: 20 dez. 2023.

ASSOCIAÇÃO BRASILEIRA DA INDÚSTRIA DO ARROZ (ABIARROZ). 2023. Disponível em: https://www.abiarroz.com.br/ . Acesso em: 31 ago. 2023.

BAJAN, B.; MRÓWCZYŃSKA-KAMIŃSKA, A. Carbon footprint and environmental performance of agribusiness production in selected countries around the world. **Journal of Cleaner Production**, *[s.l.]*, v. 276, n. 3, e123389, 2020. Disponível em: http://dx.doi.org/10.1016/j.jclepro.2020.123389. Acesso em: 20 dez. 2023.

BITZER, V. C.; NDOU, O. P. Keeping up with rising quality demands? New institutional arrangements, upgrading and market access in the South African citrus industry. **Quality and Innovation in Food Chains:** Lessons and Insights from Africa, *[s.l.],* p. 141-1591, jan. 2016. Disponível em: https://www.academia.edu/105148395/7_Keeping_up_with_rising_quality_demands_New_institutional_arrangements_upgrading_and_market_access_in_the_South_African_citrus_industry. Acesso em: 20 dez. 2023.

CHOUSOU, C.; MATTAS, K. Assessing consumer attitudes and perceptions towards food authenticity. **British Food Journal**, *[s.l.]*, n. 5, p. 1947-1961, 2019. Disponível em: http://dx.doi.org/10.1108/BFJ-03-2019-0177. Acesso em: 20 dez. 2023.

COTEUR, I. *et al.* A framework for guiding sustainability assessment and on-farm strategic decision making. **Environmental Impact Assessment Review**, *[s.l.]*, v. 60, p.

16-23, set. 2016. Disponível em: http://dx.doi.org/10.1016/j.eiar.2016.04.003. Acesso em: 20 dez. 2023.

DEPONTI, C. M. *et al.* Perfil e localização das agroindústrias familiares rurais nas regiões funcionais (RFS) de planejamento do Rio Grande do Sul. **Revista Brasileira de Gestão e Desenvolvimento Regional**, Taubaté, v. 18, n. 3, p. 3-16, 2022. Disponível em: https://www.rbgdr.net/revista/index.php/rbgdr/article/view/6592. Acesso em: 13 mar. 2023.

DUAN, S.; WIBOWO, S.; CHONG, J. A Multicriteria Analysis Approach for Evaluating the Performance of Agriculture Decision Support Systems for Sustainable Agribusiness. **Mathematics**, *[s.l.]*, v. 9, p. 1-16, 2021. Disponível em: https://doi.org/10.3390/math9080884. Acesso em: 20 dez. 2023.

FLESKENS, L.; DUARTE, F.; EICHER, I. A conceptual framework for the assessment of multiple functions of agro-ecosystems: A case study of Trás-os-Montes olive groves. **Journal of Rural Studies**, *[s.l.]*, v. 25, n. 1, p. 141-155, 2009. Disponível em: http://dx.doi.org/doi:10.1016/j.jrurstud.2008.08.003. Acesso em: 20 dez. 2023.

FONTOURA, F. B. B. TENÓRIO, F. G.; ALLEBRANDT, S. L. Contexto histórico das formas de organização da produção: repercussões organizacionais e sociais. **Redes**, Santa Cruz do Sul, v. 28, n. 1, p. 1-18, jun. 2023. Disponível em: https://online.unisc.br/seer/index.php/redes/article/view/17928. Acesso em: 20 dez. 2023.

FONTOURA, F. B. B.; TENÓRIO, F. G. Desenvolvimento Organizacional Multidimensional: uma perspectiva crítica para os estudos organizacionais. **Redes**, Santa Cruz do Sul, v. 25, n. 2, p. 590-609, maio 2020. Disponível em: https://doi.org/10.17058/redes.v25i2.14549. Acesso em: 20 dez. 2023.

GARDAS, R. R. *et al.* A hybrid decision support system for analyzing challenges of the agricultural supplychain. **Sustainable Production and Consumption**, *[s.l.]*, v. 18,p. 19-32, 2019. Disponível em: https://doi.org/10.1016/j.spc.2018.11.007. Acesso em: 20 dez. 2023.

GARIBA JÚNIOR, M. **Um modelo de avaliação de cursos superiores de tecnologia baseado na ferramenta benchmarking**. Tese (Doutorado em Engenharia de Produção) – Programa de Pós-Graduação em Engenharia de Produção, Universidade Federal de Santa Catarina, Florianópolis, 2005. Disponível em: https://repositorio.ufsc.br/bitstream/handle/123456789/102070/221785.pdf?sequence=1&isAllowed=y. Acesso em: 20 dez. 2023.

GARGOURI, E.; HAMMADI, S.; BORNE, P. A study of scheduling problem in agro-food manufacturing systems. **Mathematics and Computers in Simulation**, *[s.l.]*, v. 60, n. 3-5, p. 277-291, 2002. Disponível em: https://doi.org/10.1016/S0378-4754(02)00020-4. Acesso em: 20 dez. 2023.

GILINSKY, A.; NEWTON, S.; EYLER, R. Are strategic orientations and managerial characteristics drivers of performance in the US wine industry? **International Journal of Wine Business Research**, *[s.l.]*, v. 30, n. 1, p. 42-57, 2018. Disponível em: http://dx.doi.org/10.1108/IJWBR-08-2016-0029. Acesso em: 20 dez. 2023.

HO, G. W. K. Examining Perceptions and Attitudes: A Review of Likert-Type Scales Versus Q-Methodology. **Western Journal of Nursing Research**, *[s.l.]*, v. 39, n. 5, p. 674-689, 2017.

INSTITUTO RIO-GRANDENSE DO ARROZ (IRGA). **Arroz:** o básico mais indispensável do dia a dia. Porto Alegre: IRGA, 2019. Disponível em: https://irga.rs.gov.br/upload/ arquivos/201910/17151854-cartilha-beneficios-do-arroz.pdf. Acesso em: 14 out. 2022.

KHEDRIGHARIBVAND, H. *et al.* Sustainable Rangeland Management in Southwest Iran: Understanding Changes in Experts' Attitudes Toward Livelihood Alternatives. **Rangeland Ecology & Management**, *[s.l.]*, v. 72, n. 3, p. 433-445, 2019. Disponível em: https://doi.org/10.1016/j.rama.2019.01.005. Acesso em: 20 dez. 2023.

LEAL P.; FLORES. P. Plus values & innovative behaviour in agricultural sector at Sinaloa state. **Journal of Experimental Botany**, *[s.l.]*, v. 8, n. 3, p. 140-150, 2013. Disponível em: https://www.researchgate.net/publication/289012490_Plus_values_innovative_behaviour_in_agricultural_sector_at_Sinaloa_state. Acesso em: 20 dez. 2023.

LIZOT, M.; TROJAN, F.; AFONSO, P. Combining total cost of ownership and multi-criteria decision analysis to improve cost management in family farming. **Agriculture (Switzerland)**, Switzerland, v. 11, n. 2, p. 1392021, jan. 2021. Disponível em: https://doi.org/10.3390/agriculture11020139. Acesso em: 20 dez. 2023.

MAIA, A. G. **Econometria:** conceitos e aplicações. São Paulo: UNICAMP, 2017.

MARGOLIS, J. *et al*. A multi-objective optimization model for designing resilient supply chain networks. **International Journal of Production Economics**, *[s.l.]*, v. 204, p. 174-185, 2018. Disponível em: http://dx.doi.org/10.1016/j.ijpe.2018.06.008. Acesso em: 20 dez. 2023.

MAROCO, J. **Análise Estatística**: com utilização do SPSS. 2. ed. Lisboa: Edições Sílabo, 2003.

MINISTÉRIO DA AGRICULTURA, PECUÁRIA E ABASTECIMENTO (MAPA). **Projeções do Agronegócio:** BRASIL 2018/2019 a 2028/2029. Brasília: Secretaria de Política Agrícola, 2020. Disponível em: http://www.agricultura.gov.br/assuntos/ politica-agricola/todas-publicacoes-de-politica-agricola/projecoes-doagronegocio. Acesso em: 13 out. 2022.

MOREL, K.; LÉGER, F. A conceptual framework for alternative farmers' strategic choices: the case of French organic market gardening microfarms. **Agroecology and**

Sustainable e Food Systems, *[s.l.],* v. 40, n. 5, p.466-492, 2016. Disponível em: https://doi.org/10.3390/su10093218. Acesso em: 20 dez. 2023.

NADJA, R. A. *et al.* Decision-making process to purchase brown rice at the traditional market. **International Conference on Environmental Ecology of Food Security**, *[s.l.],* v. 681, n. 1, 2021. Disponível em: http://dx.doi.org/10.1088/1755-1315/681/1/012096. Acesso em: 20 dez. 2023.

PEÑA-GONZÁLEZ, D. *et al.* An optimization approach for the design and planning of the oil palm supply chain in Colombia. **Computers & Chemical Engineering**, *[s.l.],* n. 143, mar. 2021. Disponível em: http://dx.doi.org/10.1016/j.compchemeng.2020.107208. Acesso em: 20 dez. 2023.

RECK, A.; SCHULTZ, G. Aplicação da metodologia multicritério de apoio à decisão no relacionamento interorganizacional na cadeia da avicultura de corte. **Revista de Economia e Sociologia Rural**, *[s.l.],* v. 54, n. 4, p. 709-728, 2016. Disponível em: https://doi.org/10.1590/1234-56781806-94790540407. Acesso em: 20 dez. 2023.

REMENOVA, K.; JANKELOVA, N. Decision-making style of agribusiness managers. **Agricultural Economics (CzechRepublic)**, *[s.l.],* n. 65, p. 322-330, 2019. Disponível em: http://dx.doi.org/10.17221/289/2018-AGRICECON. Acesso em: 20 dez. 2023.

SANTOS, A. C. S.; PINTO, R. L. M. P. Aplicação da análise de correlação e regressão linear simples no setor sucroenergético brasileiro. **Exacta**, *[s.l.],* v. 16, n. 2, p. 155-167, 2018. Disponível em: https://doi.org/10.5585/exactaep.v16n2.7369. Acesso em: 20 dez. 2023.

SILVA, P.; BRISOLA, M. V. Análise do Perfil do Polo Agroindustrial do Distrito Federal e dos Distritos Agroindustriais de Rio Verde – GO, Brasil. **Revista Espacios**, *[s.l.],* v. 44, n. 4, p. 69-88, 2023.

SILVA, A.; GAZOLLA, M. Agroindústrias rurais e o desenvolvimento regional: uma análise comparativa entre os estados da Região Sul do Brasil**. Revista do Desenvolvimento Regional**, Taquara, v. 18, n. 4, p. 231-255, 2021. Disponível em: https://seer.faccat.br/index.php/coloquio/article/view/2216. Acesso em: 13 mar. 2024.

SPEARMAN, C. The Proof and Measurement of Association between Two Things. **American Journal of Psychology**, *[s.l.],* v. 15, p. 72-101, 1904. Disponível em: https://gwern.net/doc/psychology/1904-spearman.pdf. Acesso em: 13 mar. 2024.

SWAMI, D.; PARTHASARITY, D. A multidimensional perspective to farmers' decision making determines the adaptation of the farming community. **Journal of Environmental Management**, *[s.l.],* v. 264, jun. 2020. Disponível em: https://doi.org/10.1016/j.jenvman.2020.110487. Acesso em: 20 dez. 2023.

VERSIANI, A. F. *et al.* A require disolation index to support the health system during the pandemic of Covid-19 in Minas Gerais, Brazil. **IEEE Latin America Transactions**,

[s.l.], v. 19, n. 6, p. 961-969, jun. 2021. Disponível em: https://latamt.ieeer9.org/index.php/transactions/article/view/4358. Acesso em: 20 dez. 2023.

YIN, R. **Case study research:** design and methods. 5. ed. Thousand Oaks: Sage Publishing, 2014.

ZHEVORA, S. V.; TULCHEEV, V.; BORISOV, M. Innovations and Perspective Technologies in the Potato and Vegetable Subcomplex of the Agro-Industrial Complex in Russia. *In:* BOGOVIZ, A. Z. (ed.). **The Challenge of Sustainability in Agricultural Systems**. London: Springer, 2021. n.p. Disponível em: http://dx.doi.org/10.1007/978-3-030-44703-8_55. Acesso em: 20 dez. 2023.

Alvaro Neuenfeldt Júnior. Doutor. Universidade Federal de Santa Maria - UFSM. Professor Adjunto do Programa de Pós - Graduação em Engenharia de Produção. Endereço para correspondência: Av. Roraima,1000 – Sala 2057. Camobi, Santa Maria – RS – CEP 97105-900. E-mail: alvaro.junior@ufsm.br.

Andressa Rocha Lhamby. Doutoranda. Universidade Federal de Santa Maria - UFSM. Programa de Pós - Graduação em Engenharia de Produção. Endereço para correspondência: Av. Roraima,1000 – Sala 2057. Camobi, Santa Maria – RS – CEP 97105-900. E-mail: andressalhamby@gmail.com.

Submitted on: 21/12/2023 Approved on: 06/03/2024

CONTRIBUTION OF EACH AUTHOR

Conceituação (Conceptualization): Alvaro Luiz Neuenfeldt Júnior e Andressa Rocha Lhamby.
Curadoria de Dados (Data curation): Alvaro Luiz Neuenfeldt Júnior.
Análise Formal (Formal analysis): Alvaro Luiz Neuenfeldt Júnior e Andressa Rocha Lhamby.
Obtenção de Financiamento (Funding acquisition): Alvaro Luiz Neuenfeldt Júnior.
Investigação/Pesquisa (Investigation): Andressa Rocha Lhamby.
Metodologia (Methodology): Andressa Rocha Lhamby.
Administração do Projeto (Project administration): Alvaro Luiz Neuenfeldt Júnior e Andressa Rocha Lhamby.
Recursos (Resources): Alvaro Luiz Neuenfeldt Júnior.
Software: Andressa Rocha Lhamby.
Supervisão/orientação (Supervision): Alvaro Luiz Neuenfeldt Júnior.
Validação (Validation): Andressa Rocha Lhamby.
Visualização (Visualization): Alvaro Luiz Neuenfeldt Júnior e Andressa Rocha Lhamby.
Escrita – Primeira Redação (Writing – original draft): Andressa Rocha Lhamby.
Escrita – Revisão e Edição (Writing – review & editing): Alvaro Luiz Neuenfeldt Júnior e Andressa Rocha Lhamby.

Funding sources: not applicable.