RELISE

CHALLENGES AND BEST PRACTICES OF SUSTAINABLE INNOVATION IN MICRO AGRIBUSINESSES: A LITERATURE REVIEW[1]

DESAFIOS E BOAS PRÁTICAS DE INOVAÇÃO SUSTENTÁVEL EM MICROEMPRESAS DO AGRONEGÓCIO: UMA REVISÃO BIBLIOGRÁFICA

Welme Rodrigues de Souza[2]

Poliane Feitosa Siqueira[3]

Paulo Roberto Ramos[4]

ABSTRACT

One of the biggest challenges for agribusiness companies is adapting to innovations in the field of environmental sustainability, especially small and medium-sized companies. This article aims to analyze the challenges and best practices for implementing sustainable innovations in agribusiness microenterprises, seeking to understand how these companies can adopt sustainable strategies to reduce environmental impacts. The methodology consisted of a bibliographic review of articles from Periódicos CAPES and Scopus, which addressed topics such as technological, economic, and structural barriers, as well as successful practices of knowledge co-creation, social technology transfer, and decentralized management. The results showed that, despite the challenges, sustainable innovations contribute to productivity, competitiveness, and environmental impact reduction, being essential for the development of microenterprises in agribusiness. It is concluded that the adoption of public policies, strategic alliances, and specific studies are fundamental to overcoming the identified barriers and enhancing the benefits of sustainable innovations.

Keywords: sustainable innovation, agribusiness, microenterprises, sustainability, innovation, public policies.

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[2] Universidade Federal do Vale do São Francisco. welmesouza18@gmail.com
[3] Universidade Federal do Vale do São Francisco. poliane.feitosa@gmail.com
[4] Universidade Federal do Vale do São Francisco. paulo.ramos@univasf.edu.br

RESUMO

Um dos grandes desafios das empresas de agronegócios é a adequação às inovações no campo da sustentabilidade ambiental, sobretudo as pequenas e médias empresas. Este artigo tem como objetivo analisar os desafios e as boas práticas para a implementação de inovações sustentáveis em microempresas do agronegócio, visando compreender como essas empresas podem adotar estratégias sustentáveis para reduzir impactos ambientais. A metodologia consistiu na revisão bibliográfica de artigos obtidos no Periódicos CAPES e no Scopus, que abordaram temas como barreiras tecnológicas, econômicas e estruturais, bem como práticas exitosas de cocriação de conhecimento, transferência de tecnologias sociais e gestão descentralizada. Os resultados evidenciaram que, apesar dos desafios, as inovações sustentáveis contribuem para a produtividade, competitividade e redução de impactos ambientais, sendo essenciais para o desenvolvimento das microempresas no agronegócio. Conclui-se que a adoção de políticas públicas, alianças estratégicas e estudos específicos são fundamentais para superar as barreiras identificadas e potencializar os benefícios das inovações sustentáveis.

Palavras-chave: inovação sustentável, agronegócio, microempresas, sustentabilidade, inovação, políticas públicas.

INTRODUCTION

Sustainability in agribusiness has become an essential pillar for corporate competitiveness and environmental responsibility, especially in Brazil, where the sector represents a significant share of the economy. Claudino and Talamini (2013) highlight the relevance of Brazilian agribusiness in multiple aspects, including the potential of domestic production to replace imported products. However, for microenterprises in the sector - often limited in resources and advanced technologies - the implementation of sustainable and innovative practices remains challenging.

Sustainable innovation, particularly in rural and family-based contexts, offers socioeconomic and environmental benefits, but it requires cultural changes and the development of new competencies. In this scenario, capacity building emerges as an essential strategy, helping managers adopt innovative practices

and develop a critical perspective on sustainability and environmental impact. In agribusiness, where the preservation of natural resources is crucial, training can mitigate challenges such as the inefficient use of inputs and dependence on conventional agricultural practices, which are often harmful to the environment. Thus, incorporating sustainable innovations in the sector is not only a competitive advantage but a necessity to promote sustainable social and economic development.

Based on this context, this study seeks to answer the following question: what are the main challenges and best practices for implementing sustainable innovations in agribusiness microenterprises? The general objective is to analyze how these companies can adopt sustainable practices, highlighting the main challenges and identifying best practices for their implementation.

The specific objectives include: identifying the main challenges to adopting sustainable practices in agribusiness microenterprises; analyzing cases of microenterprises that have successfully implemented sustainable innovations; and evaluating the results of these practices in terms of reducing environmental impacts.

The relevance of this study lies in its contribution to deepening the discussion of the topic, opening paths for future investigations into the dynamics between sustainability, innovation, and best practices in agribusiness. In light of the growing demand for environmentally responsible business practices, the findings of this research may support a broader and more up-to-date understanding of the subject, highlighting its importance in the contemporary context.

THEORETICAL FRAMEWORK

The concept of sustainable innovation is relatively recent and emerged from the need for business practices that reconcile economic growth with environmental preservation and social well-being. According to Noronha, Ferraro, and Silva (2023), sustainable innovation encompasses the creation of new products, processes, and practices that generate economic value while taking environmental and social impacts into account. This perspective highlights the importance of balancing the economic, social, and environmental dimensions.

In agribusiness, sustainable innovation involves practices that reduce environmental impact, increase efficiency in the use of resources such as water and soil, and mitigate greenhouse gas emissions, one of the major challenges facing the sector (Pena Júnior et al., 2023). Thus, it can become a competitive advantage for companies of all sizes by encouraging continuous improvements in processes, aligning with environmental requirements, reducing costs, and adding value to the business.

For microenterprises, sustainable innovation consists of accessible and feasible practices and technologies, adapted to local conditions and integrated into the social and economic context in which they operate. According to Pacheco (2020), innovation enables the adoption of low-cost, high-efficiency solutions, promoting both the financial sustainability of microenterprises and the environmental sustainability of the region.

Agribusiness microenterprise

The concept of a microenterprise in agribusiness varies across countries and regulatory contexts, but it generally refers to small businesses with limited capital structure, few employees, and predominantly local or regional operations. In Brazil, for example, SEBRAE (2023) classifies microenterprises as those with

annual revenue of up to R$360,000 and employing up to nine workers in the commerce and services sector, or up to 19 employees in the industrial sector.

In agribusiness, microenterprises play a crucial role, being responsible for a large share of production within local and regional value chains. They supply local markets, ensure the livelihoods of communities, and drive regional economic development. Data from SEBRAE (2023) indicate that microenterprises represent a significant portion of the agricultural sector in countries such as Brazil, where agribusiness is one of the main economic pillars.

However, these companies face significant challenges in adopting sustainable practices due to capital constraints, limited access to technology, and difficulties in acquiring advanced technical knowledge related to environmental conservation and sustainability. In this context, sustainable innovation must be based on practices and solutions that are adaptable to local socioeconomic and environmental conditions, as well as compatible with the small scale of operations (Pena Júnior et al., 2023). Therefore, the development of sustainable practices in agribusiness microenterprises requires a practical approach focused on specific challenges and the implementation of best practices aimed at sustainability.

Challenges for implementing sustainable innovations in microenterprises in agribusiness.

The implementation of sustainable innovations in agribusiness microenterprises faces diverse and interconnected challenges. First, financial constraints represent a significant barrier, as these companies often have limited access to credit, which restricts investments in sustainable technologies and practices. According to Araújo et al. (2023), this scenario is further exacerbated by climate uncertainties and seasonal risks that directly affect the profitability of small producers. In addition, the financial returns from sustainable practices tend

to be realized in the long term, which may discourage microentrepreneurs who depend on immediate cash flow.

Another important obstacle is the lack of technical and managerial training, which is essential for the adoption of sustainable practices. Many agribusiness microentrepreneurs have low levels of formal education and limited management skills, making it difficult to understand and apply innovative methods. This gap in technical knowledge perpetuates dependence on conventional practices, which are generally less sustainable (Pena Júnior et al., 2023).

According to Quintam and Assunção (2023), restricted access to production technologies and up-to-date information on sustainable agricultural practices also constitutes a significant barrier. Tools such as climate monitoring systems, efficient irrigation, and organic fertilizers are often beyond the reach of microenterprises, either due to high costs or lack of availability in remote areas.

Good practices for sustainable innovation

Agribusiness microenterprises have stood out for implementing best practices in sustainable innovation that not only reduce environmental impacts but also promote economic viability. One example is the use of organic fertilizers and sustainable management practices, which improve soil quality and reduce dependence on agrochemicals. These approaches result in more fertile and productive soils over time, lowering costs associated with chemical inputs and promoting healthier agricultural production (Jesus; Santos; Perin, 2020).

Another significant innovation is the adoption of efficient irrigation technologies, such as drip irrigation systems, which substantially reduce water consumption. This technology is especially advantageous in regions facing water scarcity, reconciling environmental sustainability with greater market competitiveness (Rocha; Guimarães; Oliveira, 2024).

Partnerships with research and extension institutions also play a fundamental role by providing low-cost technologies and technical training for the adoption of innovative practices. These collaborative efforts enhance the capacity of microenterprises to integrate sustainable solutions into their operations (Holanda Júnior et al., 2024).

For more microenterprises to contribute to environmental and economic sustainability, it is essential to overcome barriers such as lack of financial support, limited access to technologies, and insufficient technical training. The positive results demonstrate that, with the use of appropriate tools, it is possible to implement innovative and sustainable solutions, strengthening adaptive capacity and fostering the development of the agricultural sector.

METHODOLOGY

This study was conducted through a bibliographic research approach, defined by Marconi and Lakatos (2005, p. 160) as a comprehensive review of the main academic works published, recognized for their relevance and for contributing current and significant data on the topic under investigation.

To answer the research question, data collection was carried out in the Scopus and CAPES Journals databases through a manual search using the following expressions: “Inovação” OR “Innovation” AND “Microempresa” OR “micro business” AND “Agronegócio” OR “Agricultura” OR “Agribusiness” OR “Agriculture”.

The inclusion criteria adopted were: (a) studies published within the last five years (2019 to 2024) and (b) studies written in Portuguese or English. The exclusion criteria were: (a) studies whose titles did not show a connection between Sustainable Innovation, Microenterprises, and Agribusiness, and (b) studies whose abstracts did not indicate a clear relationship among these themes.

The 128 articles excluded in the initial screening phase of the CAPES database were discarded after a careful analysis of titles and abstracts, due to the absence of a direct and clear relationship with the topic of sustainable innovation in agribusiness microenterprises. These studies predominantly addressed technological innovations aimed at large companies or macroeconomic issues, without a specific focus on the context of microenterprises or on the integration of environmental and social practices.

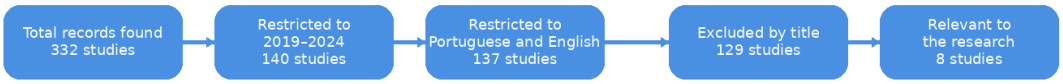
Regarding the eight articles selected, most adopt qualitative approaches, such as case studies and descriptive analyses, while few present robust quantitative data. Although the predominance of qualitative methods provides detailed and contextualized analyses, it somewhat limits the generalization of the results, especially in regions with distinct socioeconomic and environmental characteristics.

RESULTS ANDE DISCUSSION

When conducting the search in the databases on November 12, 2024, 327 results were obtained in CAPES Journals and 5 results in Scopus. In order to identify the most recent works on sustainable innovations in agribusiness micro-enterprises, a filter was applied to restrict the search to works published in the last five years (2019 to 2024), resulting in 137 works in CAPES Journals and 3 in Scopus. In addition, a language filter was applied, limiting the search to articlesworks in Portuguese and English, which reduced the total to 134 in CAPES Journals and maintained 3 in Scopus.

After the initial survey, a screening was carried out to refine the results. First, the titles were read to identify the works most aligned with the research proposal. As a result, 128 artciles were excluded from CAPES Journals and 1 article was excluded from Scopus, totaling 8 articles selected for the research. This selection process is illustrated in Figure 1.

Figura 1 – Framework for selection of articles



Source: Elaborated by authors.

Thus, eight papers were selected and read in full. Table 1 presents some characteristics of these papers, such as: title, author, and content covered.

Table 1 - Articles selected from Scopus and CAPES Journals.

N°	Title of the research paper	Author/Year	Content Covered
1	The digital divide: Implications for agribusiness and entrepreneurship. Lessons from Wales	Robert Bowen e Wyn Morris (2019)	Impacts of limited broadband internet access on agribusiness and rural entrepreneurship activities in Wales.
2	Farmer regeneration and knowledge co-creation in the sustainability of coconut agribusiness in Gorontalo, Indonesia	Wawan K. Tolinggi, Darmawan Salman, Rahmadanih, e Hari Iswoyo (2022)	Regeneration of farmers and the co-creation of knowledge between generations contribute to the sustainability of coconut agribusiness in Gorontalo, Indonesia.
3	Integrative Viewpoint for Implementing Sustainable Management Agricultural Business Excellence	Mykhailo Sahaidak, Mariia Tepliuk, Victoria Zhurylo, Natalia Rudenko, Olesia Samko (2021)	Assessment of business excellence in agricultural companies based on innovation indicators in Ukraine, bringing new horizons for development.
4	Impact of digitalization on the effectiveness of management in the field of agricultural development	Mikhail Kostomakhin, Nikolay Kostomakhin, and Mikhail Tseiko (2023)	Digitization as a modernization tool, contrasting centralized and decentralized management models, countries like Italy and Germany as decentralized models and the USA as a centralized model.

continues

Table 1 - Articles selected from Scopus and CAPES Journals.

N°	Title of the research paper	Author/Year	Content Covered
5	Activities of Small Businesses in the Crop Production of the Kurgan Region	Mariya V. Karpova, Nina V. Roznina, Elena N. Lapina, Marina V. Pavluckich, e Marina I. Zakharova (2021)	The activities of small businesses in agricultural crop production in the Kurgan region, Russia.
6	Transferência de tecnologia e troca de saberes para a agricultura familiar: uma inovação sustentável em Paragominas – Pará	Abimael Oliveira dos Santos, Djenane de Guáqueta, Laíze Ramalho da Silva Santos, Lorena Carla Souza da Silva, Rosana Cardoso Rodrigues da Silva e Roberto Antônio dos Reis Gomes (2021)	Transfer of social technologies, developed by EMBRAPA through the Support and Research and Technology Transfer Center (NAPT), in the development of family farming in the municipality of Paragominas (PA).
7	Determinants of ICT Adoption Among Small Scale Agribusiness Enterprises In Somalia	Husein Osman Abdullahi , Abdikarim Abi Hassan, Murni Mahmud, Abdifatah Farah Ali (2021)	Importance of agriculture to the Somali economy, where ICTs are seen as crucial tools to boost productivity, disseminate information and provide competitive advantages for agribusiness.
8	Small business environment and development problems in the Russian Federation	Nina Kuznetsova, Antonina Ilyina, Maxim Mironov, Antonina Korolkova, and Tatiana Marinchenko (2021)	Challenges faced by small businesses and the support measures implemented by the government to promote their growth, describing a series of government programs and initiatives aimed at stimulating growth, increasing productivity, innovation and competitiveness of small businesses in Russia.

Source: Elaborated by authors.

The examples presented in Table 1 highlight diverse practices and contexts of sustainable innovation and can be further enriched with details on the quantitative impacts observed in the studies. For instance, the study on the adoption of efficient irrigation systems in Brazil revealed a reduction of up to 30% in water consumption among agricultural microenterprises that implemented drip irrigation technologies, improving productivity without compromising water resources. In Indonesia, the co-creation of knowledge between generations of

farmers resulted in a 15% increase in coconut production efficiency, in addition to strengthening the socioeconomic resilience of communities. In Ukraine, the application of sustainable innovation indicators increased the competitiveness of small agricultural enterprises by 20%, especially in markets that value environmentally responsible practices. These data reinforce the effectiveness of the practices analyzed and demonstrate that initial investments in sustainable technologies can generate significant returns over time.

However, the implementation of these best practices faces challenges and contradictions. In the case of efficient irrigation, for example, the high initial installation cost may be prohibitive for microenterprises with capital constraints, requiring access to affordable financing mechanisms. In addition, dependence on technological infrastructure - such as internet access for remote monitoring - may limit adoption in rural regions with poor connectivity, as observed in the study conducted in Wales.

Knowledge co-creation, although promising, may encounter cultural or generational resistance, with more experienced farmers being reluctant to adopt new practices proposed by younger generations. These contradictions highlight the need for inclusive public policies and implementation strategies adapted to local contexts, ensuring that best practices are applicable and sustainable across different socioeconomic realities.

The analysis of the selected articles revealed different perspectives on the challenges and best practices for implementing sustainable innovations in agribusiness microenterprises, encompassing diverse contexts and highlighting technological, social, and policy-oriented approaches. The article by Robert Bowen and Wyn Morris (2019) emphasized the impact of limited broadband internet access as a significant challenge for agribusiness in rural areas of Wales, restricting access to critical information, innovation, and markets, and thus hindering competitiveness. Similarly, the study by Husein Osman Abdullahi et al.

(2021) addressed the challenges of adopting ICTs (Information and Communication Technologies) in microenterprises in Somalia, noting that limited infrastructure prevents the effective use of these tools.

In Russia, the articles by Mariya V. Karpova et al. (2021) and Nina Kuznetsova et al. (2021) identified structural and economic barriers - such as the lack of effective public policies, restricted access to credit, and low innovation capacity - that compromise the adoption of sustainable practices, even in an environment where sustainability is increasingly demanded.

The article by Wawan K. Tolinggi et al. (2022) highlighted farmer regeneration and intergenerational knowledge co-creation as key factors for the sustainability of the coconut agribusiness in Indonesia. These practices promote knowledge exchange and the continuity of innovative practices by integrating traditional and modern knowledge. In Brazil, the study by Abimael Oliveira dos Santos et al. (2021) examined the transfer of social technologies to family farming in Paragominas (PA), emphasizing its effectiveness in farmer training and in integrating sustainable innovation into the local context, thereby reducing environmental impacts.

Mykhailo Sahaidak et al. (2021) presented an integrated approach to business excellence in agricultural enterprises in Ukraine, using innovation indicators to measure sustainability and highlighting the importance of analytical tools to optimize practices and reduce waste.

The studies analyzed demonstrate that the adoption of sustainable innovations in agribusiness microenterprises, when properly implemented, can generate significant benefits. Examples include increased agricultural productivity, as evidenced in Somalia and Ukraine, and reduced environmental impacts, as highlighted in technological transfer practices in Brazil. The cases of Italy and Germany, presented by Mikhail Kostomakhin et al. (2023), show that decentralized management models combined with digitalization promote greater

efficiency in the implementation of sustainable innovations, serving as a relevant example for other regions.

Practices such as the use of organic fertilizers, efficient irrigation systems, and sustainable waste management, although they may initially require financial investments and operational changes, offer significant medium- and long-term benefits. These include reduced costs associated with chemical inputs, more efficient use of natural resources, and increased market competitiveness due to the growing value placed on sustainably produced goods. Such practices may also attract tax incentives and sustainability-focused financing, mitigating the initial cost burden. An analytical model that quantifies the financial and environmental returns of these initiatives can serve as a strategic tool for microentrepreneurs, helping them overcome economic barriers and make decisions based on concrete data.

FINAL CONSIDERATIONS

The results of this research demonstrate that the main challenges faced by agribusiness microenterprises in adopting sustainable innovations include technological, economic, and structural barriers. However, best practices such as knowledge co-creation, the transfer of social technologies, and the use of analytical tools offer promising pathways to overcome these limitations.

Sustainable innovations, in addition to contributing to the reduction of environmental impacts, promote improvements in productivity and business competitiveness. Nevertheless, their successful implementation requires the integration of efforts among government, academia, and the private sector, as well as public policies that encourage the adoption of these innovative practices.

To strengthen the applicability of the results, it is recommended that agribusiness microenterprises prioritize training for managers and employees in sustainable innovation practices, through partnerships with educational and

research institutions that offer accessible technical training. The government, in turn, can play a crucial role by creating specific public policies, such as subsidized credit lines, tax incentives for sustainable initiatives, and technical assistance programs tailored to the needs of microenterprises. Society, represented by consumers and civil society organizations, can also support these initiatives by valuing products derived from sustainable practices. The integration of these efforts enhances the ability to overcome the identified barriers and encourages an effective transition toward sustainable business models in the agricultural sector.

This study contributes to the understanding of the dynamics of sustainable innovation in agribusiness microenterprises, offering valuable insights to guide future research and practices in this field. As a future direction, the development of detailed case studies is suggested in order to deepen the analysis of the economic and environmental impacts of these innovations.

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