



BAR - Brazilian Administration Review

ISSN: 1807-7692

ANPAD - Associação Nacional de Pós-Graduação e Pesquisa em Administração

Agripino, Najara Escarião; Maracajá, Kettrin Farias Bem; Batalhão, André C. S.  
Determining Priority and Sustainable Strategies in Agribusiness  
Management using an Analytic Hierarchy Process model  
BAR - Brazilian Administration Review, vol. 20, no. 4, e230029, 2023  
ANPAD - Associação Nacional de Pós-Graduação e Pesquisa em Administração

DOI: <https://doi.org/10.1590/1807-7692bar2023230029>

Available in: <https://www.redalyc.org/articulo.oa?id=84176391002>

- How to cite
- Complete issue
- More information about this article
- Journal's webpage in redalyc.org

UABM  
redalyc.org

Scientific Information System Redalyc  
Network of Scientific Journals from Latin America and the Caribbean, Spain and  
Portugal

Project academic non-profit, developed under the open access initiative

# Determining Priority and Sustainable Strategies in Agribusiness Management using an Analytic Hierarchy Process model

Najara Escarião Agripino<sup>1</sup> , Kettrin Farias Bem Maracajá<sup>1</sup> , André C. S. Batalhão<sup>2</sup> 

<sup>1</sup> Universidade Federal de Campina Grande, Campina Grande, PB, Brazil

<sup>2</sup> NOVA University Lisbon School of Science and Technology, Caparica, Portugal

**How to cite:** Agripino, N. E., Maracajá, K. F. B., & Batalhão, A. C. S. (2023). Determining priority and sustainable strategies in agribusiness management using an analytic hierarchy process model. *BAR-Brazilian Administration Review*, 20(4), e230029.

**DOI:** <https://doi.org/10.1590/1807-7692bar2023230029>

## Keywords:

sustainability; strategic planning; agricultural sector; AHP.

## JEL Code:

N56

## Received:

December 12, 2022.

This paper was with the authors for two revisions

## Accepted:

September 01, 2023.


## Publication date:

October 18, 2023.


## Corresponding author:

Kettrin Farias Bem Maracajá  
Universidade Federal de Campina Grande  
Rua Aprígio Veloso, 882 Universitário, CEP 58701-030,  
Campina Grande, PB, Brazil


## Editor-in-Chief:

Ivan Lapuente Garrido   
(Universidade do Vale do Rio dos Sinos, Brazil).

## Associate Editor:

Vilmar Antonio Gonçalves Tondolo   
(Universidade Federal de Pelotas, Brazil).

## Reviewers:

André Andrade Longarav   
(Universidade Federal de Santa Catarina, Brazil)  
and one anonymous reviewer

## Editorial assistants:

Eduarda Anastacio, Kler Godoy, and Simone Rafael  
(ANPAD, Maringá, Brazil).

## ABSTRACT

The aim of this study was to analyze which business sustainability factors are adopted in the strategic process of the agricultural sector using the model named Strategic Planning for Business Sustainability (PEPSE). To achieve the proposed aim, the PEPSE model was applied to the Analytic Hierarchy Process multicriteria decision tool. During the research, the farm adopted sanitary measures due to the COVID-19 pandemic, which compromised access to managers and, consequently, data collection. Based on the application of a model developed especially for the identification and formulation of sustainable strategies, the study identified how sustainability is considered in the strategic planning of an agricultural unit in Brazil and the strategies adopted to deal with environmental variables. It was possible to understand how the stakeholders influence the planning of the farm and the variables and priority strategies for the environmental positioning of the farm. Thus, the main limitation of the research was the time and the collection of information, therefore, only an analysis of the external scenario of the farm was carried out.



**Data Availability:** Najara Escarião Agripino, Kettrin Farias Bem Maracajá, & André C. S. Batalhão. (2023). Determining priority and sustainable strategies in agribusiness management using an Analytic Hierarchy Process model" published by BAR - Brazilian Administration Review [Data set]. Mendeley Data. <https://data.mendeley.com/datasets/362vp4yyw9/1>.

The authors claim that they do not have authorization from the ECF platform to make the survey data available to the public. BAR - Brazilian Administration Review encourages data sharing but, in compliance with ethical principles, it does not demand the disclosure of any means of identifying research subjects.

**Plagiarism Check:** BAR maintains the practice of submitting all documents received to the plagiarism check, using specific tools, e.g.: iThenticate.

**Peer review:** is responsible for acknowledging an article's potential contribution to the frontiers of scholarly knowledge on business or public administration. The authors are the ultimate responsible for the consistency of the theoretical references, the accurate report of empirical data, the personal perspectives, and the use of copyrighted material. This content was evaluated using the double-blind peer review process. The disclosure of the reviewers' information on the first page is made only after concluding the evaluation process, and with the voluntary consent of the respective reviewers.

**Copyright:** The authors retain the copyright relating to their article and grant the journal BAR - Brazilian Administration Review, the right of first publication, with the work simultaneously licensed under the Creative Commons Attribution 4.0 International license (CC BY 4.0) The authors also retain their moral rights to the article, including the right to be identified as the authors whenever the article is used in any form.

## INTRODUCTION

The changes that have occurred in the current market impose, in addition to economic and structural factors, responsibilities regarding socio-environmental issues, directing the movement of organizations in search of understanding sustainable development and strategies to make it attainable (Söderholm, 2020). In this regard, although often motivated by social pressures, the efforts made to find solutions to the problems that impact the planet are notorious.

Although the pressures on organizations regarding the incorporation of sustainability in their management process have intensified, especially since the 1990s — in the debates on sustainable development —, such inclusion is not a recent discussion, having been strongly influenced even in the 1960s by understanding that companies have responsibilities to society through debates surrounding the term ‘corporate social responsibility’ (Agudelo et al., 2019; Carroll, 2015).

With relative intensity, organizations cause socio-environmental and economic impacts on the space they occupy and develop their productive activities. It is known that some sectors, due to the nature of their activities, end up being identified as critical to the environment. In Brazil, the economic sectors that most cause environmental impacts are mining, industry, and agribusiness, and these are also the economic activities that most influence the gross domestic product. The country is a world reference in the production and export of agricultural products, the main economic activity and which, according to data from the Ministry of Agriculture, Livestock, and Supply (MAPA), should reach a gross value of 1.216 trillion in the year 2023, an increase of 4.7% compared to 2022 (Ministry of Agriculture and Livestock, 2023).

Through agricultural activities, human beings have been able to minimize and even eliminate natural obstacles to achieving food production and guaranteeing food security. Techniques used, such as crop rotation, soil correction, irrigation, and pest control, allowed for greater autonomy in the production of foodstuffs. On the other hand, conventional agricultural practices have negatively impacted the natural environment. It is estimated that over the past 150 years, half of the most productive soil has disappeared worldwide, threatening the future of production and contributing to river pollution, soil erosion, and increased dead zones (Montgomery, 2018; Rose, 2008).

Due to the critical aspects of the sector, both society and non-governmental organizations (NGOs) and even international importers have been demanding that Brazilian producers adopt new practices that meet

sustainability criteria (Reuters, 2020). In this context, today, the main challenge faced by agriculture and livestock is to promote the expansion of its businesses with the least possible impact on the environment.

As for the exploitation of natural resources, the current great challenge is to understand and evaluate the impacts caused by the organizational system, so that it is possible to generate greater sustainability in practical actions. From this, this research seeks to answer the following research question: What are the business sustainability factors that act as the most important in the strategic process of the agricultural sector?

In the initial theoretical review on the Web of Science database, a notable uptick in work on corporate sustainability over the past decade was observed, especially from 2015 to 2021, accounting for 1,289 articles. However, only a handful specifically addresses strategic planning and corporate sustainability (49 articles). A significant portion of these works stem from theses or dissertations in the sector. The studies predominantly targeted the mining, financial, and agribusiness industries. In terms of strategic planning tools for corporate sustainability, the PEPSE methodology was cited twice, and the balanced scorecard once.

To underscore the novelty of our study, we undertook a meticulous review of these articles to discern the methodologies, approaches, and outcomes presented. We ascertained that while many studies underscored the criticality of integrating sustainability into strategic planning, few delved into the actual mechanisms of such integration within organizations, particularly in the milieu of Brazilian agribusiness. Additionally, there was a prevailing inclination toward purely qualitative research in the studies. This reveals a research gap, signaling the necessity for a deeper focus on the decision-making processes of top-tier company management and a combined qualitative-quantitative method to comprehensively examine the variables in question.

Our research thus differentiates itself by furnishing an in-depth exploration of tangible integration strategies between strategic planning and corporate sustainability within Brazilian agro-industrial enterprises. Moreover, we employed a semi-qualitative methodology, enabling us to discern patterns and grasp the intricacies linking these two concepts. This methodology unveiled insights that earlier studies did not thoroughly explore, positioning our research as a unique and invaluable addition to the academic sphere.

Integrating the PEPSE model with multicriteria decision-making, augmented by the use of the AHP, our

study endeavored to evaluate corporate sustainability factors within the strategic framework of the sector, grounded on the strategic planning for corporate sustainability (PEPSE) model. With these foundational principles, we aim to enrich future studies, addressing and filling the extant gap in scientific research on this topic.

As for the choice of methods, after reviewing the literature, we identified that the AHP method is the most suitable for achieving the proposed objectives since it deals specifically with problems in which the factors studied are not interdependent for hierarchy. In addition, the AHP method aims to translate the decision-maker's priorities so that the evaluation result is faithful to the organizational reality. It is a process that structures thinking for decision-making and not an algorithm that aims to solve problems. Thus, it is suitable for the proposed problem since it provides objective, precise, and easy-to-implement results in the organizational environment. The PEPSE is a strategic planning model specifically developed to cover environmental variables and present to industries a tool that explains the organization's reality concerning the natural environment and sustainability. Thus, PEPSE is a suitable model for the study.

The following section presents a strategic planning model for corporate sustainability in which the challenges for companies to become sustainable and competitive are discussed. Subsequently, the AHP model facilitates its operation and application in similar studies in the international literature. The PEPSE model was presented, a tool developed to help industries analyze and develop environmental strategies. The methodological approach and research steps sections present the methods and techniques used in carrying out the research, and it presents the developed steps, research subjects, and structuring of the multicriteria decision problem. The following section is about the discussions, highlighting the main findings of the research and discussions on the company's sustainable strategies. Finally, there are the conclusions and future reflections of the study, indicating the main points discussed, recommendations for the organization, and future research.

## THEORETICAL BACKGROUND

### Strategic planning model for business sustainability

Among all the challenges to be faced by modern organizations, one of the most complex is undoubtedly the search for a management model that allows them to be competitive while employing sustainable practices. With the relevance that sustainability has acquired in today's

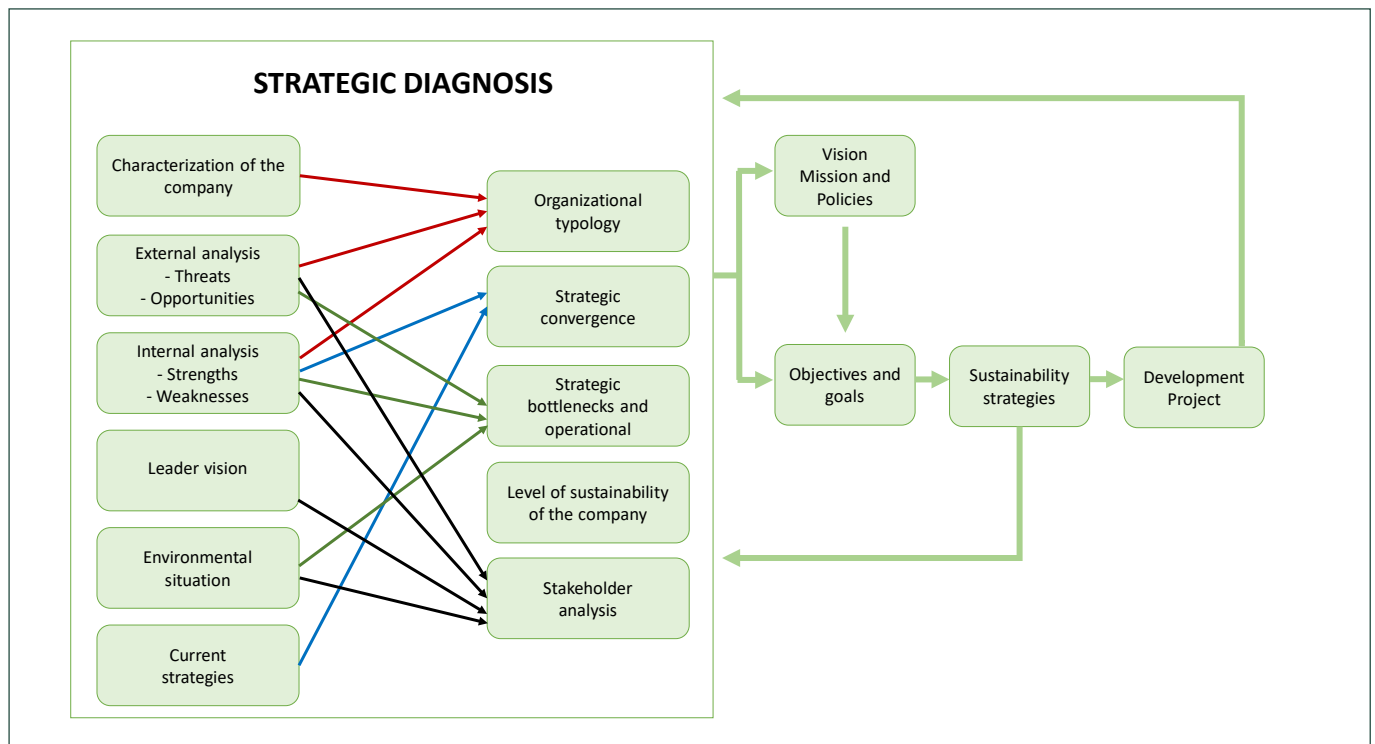
society, private sector actions toward social and environmental problems are no longer mere philanthropic options to become strategic actions (Lahti et al., 2018).

Socio-environmental management brings benefits to organizations not only in terms of achieving sustainability, but also positively impacts organizational performance, as it establishes an image of social awareness and commitment to the problems that affect the community (Cohen et al., 2021). Given this, many authors throughout the 1980s and 1990s proposed models for the development of sustainable strategies aimed at filling the gaps in traditional strategic planning models. The aim would be to provide companies with a better structuring of their decision-making process, encompassing the principles of sustainability in their economic business model, to meet market expectations and remain competitive in the face of the new demands of their stakeholders (Nosratabadi et al., 2019; Purvis et al., 2019).

Based on the strategic planning (SP) models, focused primarily on economic factors and based on models for formulating and implementing environmental strategies (Hart, 1995; 1997; Reinhardt, 1999; Sharma, 2000; Shrivastava, 1995; Stead & Stead, 2000), the PEPSE model was developed with the aim of providing industries with a planning tool that helps in the analysis of their position concerning sustainability variables, improving their performance and adaptation to operate in future markets without losing focus on the sustainable development (Coral, 2002).

In this way, the model presents as its main contribution the structuring of the information obtained in the strategic diagnosis for the elaboration of sustainable strategies and the choice of the most adequate tools for its implementation (Coral et al., 2003). In the PEPSE model, the stages of strategic diagnosis, elaboration of sustainable strategies, and development projects differ from traditional SP models due to their sustainable approach. Thus, in PEPSE, the strategic diagnosis is composed of two stages: (1) data collection and data analysis, whose results will serve as a subsidy for decision-making and definition of objectives and goals; and (2) development of sustainable strategies (Figure 1).

The data collection phase encompasses the steps of characterizing the company, analyzing the internal and external environment, the leader's vision, the environmental situation, and current strategies. The analysis of data from the strategic diagnosis requires compliance with the steps of organizational architecture, analysis of stakeholders, strategic and operational bottlenecks, and the degree of sustainability of the company. Below, the steps of each phase of the model will be detailed (Coral, 2002).



**Figure 1.** Strategic planning model for corporate sustainability

Source: Developed by the authors, based on Coral et al. (2003).

Similar to the other PE models, the analysis of the external environment of the PEPSE model seeks to identify the company's competitive strengths, as well as its points of vulnerability that could lead it to succumb to environmental adversities. In the analysis of competitive forces by Porter (2008), the government is considered an actor that can influence competitiveness. Thus, the PEPSE model considers the government and adds society and the environment as factors that influence all actors in the model. The internal analysis comprises the survey of information about the organization's infrastructure, the management models adopted and the observation of the company's strengths and weaknesses, and will serve as a basis for the characterization of the organizational typology and architecture (Coral et al. 2003).

As variables, Coral et al. (2003) indicate for analysis of the internal environment: strategic management, human resources, information management, product development, process management, production technologies, logistics, commercialization and marketing, financial management, environmental management, and quality assurance. As variables for the external environment: customers, suppliers, substitute products, competitors, intensity of rivalry among competitors, potential entrants, government, society, and natural environment. Considering all the variables in this model, PEPSE proves to be an efficient support tool for organizations that wish to know their position about sustainability variables, as well as correct possible bottlenecks that could compromise their

sustainability. In addition, by combining traditional PE models with environmental models in a single methodology, we can provide broad knowledge about the organization's reality, preparing it to meet the demands of future markets.

The present work did not intend to apply the model in its entirety since the objective was not to evaluate the farm's sustainability (it already has certifications that attest to its sustainability) but only to identify in its planning the environmental variables and strategies that make it a model in the sector. In pursuit of this objective, the specific environmental variables and strategies suggested or highlighted in the model were employed to address the external environment and identify the sector's variables. Once these variables have been identified, the study aims to pinpoint those that have a significant impact on agricultural units.

## AHP

According to Saaty (1991), the AHP method was designed similarly to the way the human mind works, so when faced with a large number of elements, the human mind will consolidate them into common groups, repeating the process to aggregate them into higher groups until reaching the central objective of the problem. For the author, one of the most important steps in the decision-making process is the selection of priority factors. Saaty (1991) recommends five phases for the application of the AHP. They are structuring criteria and alternatives; collection

of judgments; calculation of priorities; verification of the consistency of the decision; and calculation of the global priorities of the alternatives.

The criteria structuring step models the problem by decomposing it into systematic hierarchies, from the top (general objective) to the last level (alternatives). The hierarchy of the AHP structure has three to four levels (objective, criteria, sub-criteria [optional], and alternatives). In the model, adjustments are made by assigning weights to each criterion. The more criteria there are, the lower the individual criterion weight becomes (Ishak et al., 2019).

The decision-makers' judgment collection step uses a pairwise comparison between two elements of the same level based on the immediately superior focus element from a square matrix, whose order follows the number of elements subordinate to the node immediately above. The subordinate elements are organized in the same order, forming the rows and columns of the matrix (Saaty, 1991).

The priority calculation step is to obtain the relative priority of each criterion. To reach this value, it is necessary: (a) to normalize the values of the matrix, equating all the criteria to the same unit. The literature points out at least eight ways of carrying out the normalization, the most used being the arithmetic method, which considers the values of each line by calculating the average to obtain the corresponding weights and classifications (Saaty & Vargas, 2012), and the geometric mean method, where the vector is the  $n$ th root of the products; (b) obtaining the priority vector.

The AHP used academic research regarding agribusiness. According to Yuan et al. (2022), from an analysis of the international literature of the last eight years on the use of multicriteria decision methods in studies on sustainability assessment in rural units, the AHP method has been the most used, followed by Delphi and TOPSIS.

The first study on sustainable assessment in rural areas using the AHP was in 2005 (Hill et al., 2005); after this study, the number of publications on the subject using the method only increased, especially in the last five years. They applied to site selection, tourism, and habitat (Yuan et al., 2022). Among these studies, the work by Chuma et al. (2021) stands out, which applies the AHP to analyze the suitability of land use for agroforestry around the Itombwe Nature Reserve (RNI) in eastern Democratic Republic of Congo; Sari et al. (2020) apply the AHP to assess the suitability of the site for beekeeping to increase the productivity of the activity; and Bartzas and Komnitsas (2019) use the AHP to propose a holistic methodology that integrates life cycle analysis and environmental risk assessment to identify the most sustainable practices of sustainable agricultural management at a regional level on the island of Aegina, Greece.

## METHODOLOGY

The research uses a mixed approach. The mixed methods approach is the general term when quantitative and qualitative data collection techniques and analysis procedures are used in a research design (Timans et al., 2019). The choice for the mixed approach is justified by the possibility of obtaining better analytical alternatives for the data, meeting the proposed objectives (Ruiz, 2021). In this sense, a multimethod emphasis was chosen, as it is the most appropriate to the research question — qualitative front due to the descriptive character of the phenomenon; quantitative front due to the possibility of organizing hierarchically according to the degree of importance of the variables that, according to the research subjects, are judged to be the most important. The research method includes five main steps: (1) literature review process, (2) develop a questionnaire survey, (3) data collection, (4) processing data, and (5) analytical hierarchy process model application.

### Research techniques

Literature review and questionnaires were applied as research techniques. From the literature review, it is possible to deepen and better understand the subject, as well as formulate the necessary content categories for the application of questionnaires and analysis of data obtained in the field research (Snyder, 2019).

### Literature review process

The literature review was carried out to identify and select peer-reviewed scientific publications, critical works, journalistic articles, and reports that would corroborate the deepening of the subject and the identification of works previously selected to shed light on the investigated phenomenon.

Initially, the data were collected through a survey of scientific productions in the Web of Science database on May 25, 2021, using the words 'corporate sustainability,' 'business sustainability,' and 'sustainability in agribusiness' as descriptors. The Boolean combination 'or' resulted in 1,766 documents filtered into scientific articles published in English and Portuguese between the years 2005 to 2021. The definition of the period collects information about the last 15 years of studies on the topic. The countries and languages were delimited based on the country with the most registered publications on the subject (USA) and the research topic: Brazilian agribusiness (Brazil). After delimiting the areas related to the theme ('management,' 'business,' 'business finance,' and 'economics'), we found 209 articles. Later the research was repeated with the descriptors 'corporate sustainability' and 'agribusiness' with the Boolean combination 'and,' which resulted in three articles in the English language. Finally, the descrip-



tors 'corporate sustainability' and 'strategic planning' with the Boolean combination 'and' resulted in 49 articles in English and 16 in Portuguese.

Finally, a search was also carried out in the Portal Capes database on May 26, 2021, using the descriptors 'corporate sustainability,' 'sustainability in agribusiness,' and 'sustainable practices in agribusiness.' In this search, only works in Portuguese published between 2005 and 2021 were used, which resulted in 36 documents.

After selecting the material, there was a preliminary reading of the titles and abstracts of the works, identifying the object, objectives, and methodology. In the end, there were 20 articles for the study to be carried out. The criterion for including results in the research development was the theme approach and the relationship between corporate sustainability and agribusiness. The studies combined the two themes and a semi-qualitative approach for the construction of the theoretical framework.

To complement the selection of materials, books and theses in PDF versions available in virtual repositories of Brazilian public universities were also used, as well as articles on the multicriteria model applied in research and documents published by Brazilian bodies and entities on agribusiness.

### Developing a questionnaire survey

The study is focused on the productive agricultural sector, given its crucial significance for the country's economy and its association with socio-environmental issues. Concerning the research topic, considering that the phenomena related to sustainability are still a topic under construction in the administration area, especially about agribusiness as an object of study, it is hoped that the work will contribute to a better understanding of the topics addressed, generating greater depth on strategic planning and its application in corporate sustainability and highlighting the importance of planning focused on environmental variables for better positioning of companies in the sector.

Regarding the choice of the farm as the object of study, it is a national and international model farm in terms of sustainability. In addition, the farm has stood out in the agricultural sector due to its production model combining organic and biodynamic practices in producing safe and quality food, which guarantees national and international certifications for sustainable production. The farm also develops its production technologies, allowing it to grow products previously unimaginable in the region, such as organic spirulina.

This time, the choice of direction for the research followed the economic importance of the agricultural sector for Brazil, since this is still one of the main factors responsible for the growth of the national GDP, and its

relationship with the social and environmental impacts, since in the last years the country has stood out due to the environmental disasters associated with bad practices in agriculture. The farm, in turn, was selected because of its location — the sertão of Paraíba, whose geographical characteristics are the semi-arid climate with the typical Caatinga vegetation of the sertão and low rainfall records, which implies long cycles of droughts — understood as a region with limited resources for agricultural practices, environmental certifications, and production model.

The research subjects were the farm production manager and public relations. Both by the farm owner as the employees with the greatest knowledge of the company's management. In addition, decisions regarding organizational objectives in the production manager. During the research, the production manager suffered an accident and had to be away from his activities. For this reason, the responsibilities were delegated to the public relations department. The production/operations manager has 23 years of experience on the farm, is an agronomist, and is responsible for the entire farm management process. The public relations manager has been with the company for four years, holds a Ph.D. in social sciences; is a researcher in rural sociology, sustainable development, and rural properties; and is a full professor with about 17 years of experience being responsible for establishing partnerships with institutions and other companies, cultural activities, content for social media, and activities at Farm School.

In AHP, the analysis was realized by an actor called the decision-maker, but as the interested party in this organizational system does not have decision-making power, by decision of the project, it was chosen to call it evaluator. It should be noted that the evaluator's participation, although not part of the decision-making process, is indicated by the owner since this employee has extensive knowledge and a holistic view of the organization. In addition, the decision regarding business management is centralized in the figure of the production manager.

### DATA COLLECTION

Data collection took place in two stages: (a) application of a semi-structured interview with the production manager; and (b) the application of the AHP matrix with the evaluator. The interview was conducted in person, at Fazenda Tamanduá on July 21, 2021, from 8:00 am to 9:30 am, with the recording authorized by the interviewee. The aim of the interview was to obtain information about the strategic planning of the farm given the variables of the external environment. For this purpose, the variables indicated in the PEPSE model were used as a basis (customers, suppliers, competitors, substitute products, potential entrants, intensity of rivalry among competitors, government, society, and the natural environment). The

interview script followed the criteria adopted by researcher Coral (2002) for applying the model.

Based on the interview with the production manager, who stated that there are no direct competitors for the farm's products since production is organic and biodynamic, the variable intensity of rivalry among competitors was removed from the data analysis.

### Processing data

The process of qualitative data analysis was carried out using the technique of content analysis through the application of categorization and coding mechanisms. Following the suggestions of Faria-Schützer et al. (2021), the study adopted a coding mechanism based on three steps: descriptive coding of data to find categories related to the sustainability variables defined in the PEPSE model and to categorize the sustainable actions described by the interviewed manager.

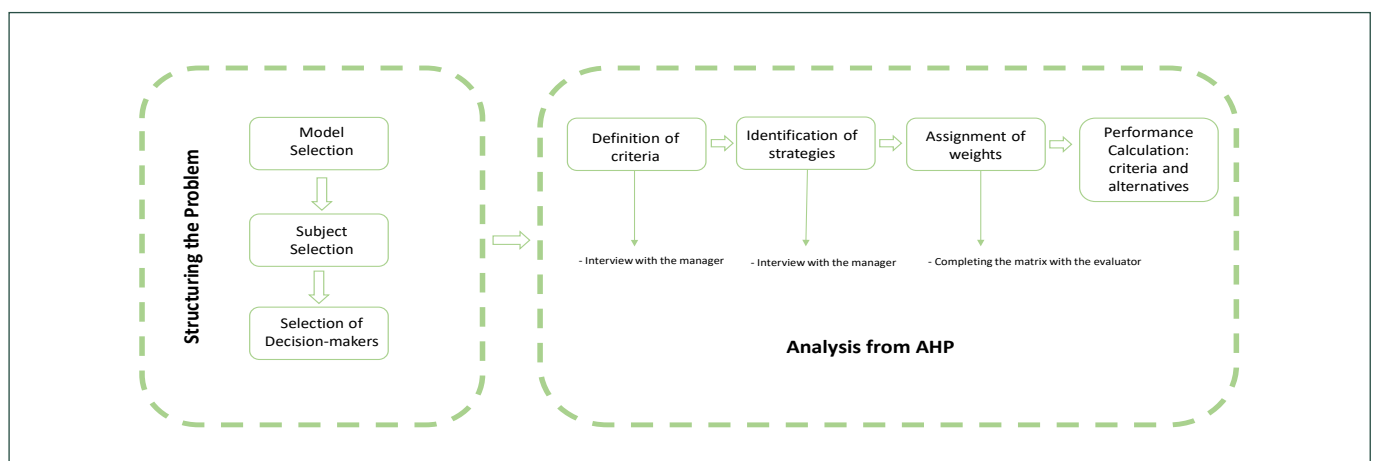
The qualitative stage was applied to identify the criteria adopted by the farm and the respective strategies to deal with the external environment. Thus, the analysis categories of the study were relevant, formulated from the proposed objectives and closed grid, based on the external variables present in the PEPSE model (Opoku et al., 2021). The study did not intend to apply the method itself, but to use it as a basis for identifying the priority strategies that the company has adopted to remain competitive in the sector and meet the assumptions of corporate sustainability.

From the qualitative findings, the data were submitted to quantitative analysis using the multicriteria decision support method from the analytic hierarchy process (AHP) methodology. Thus, after the interview, a pre-test was initially carried out with an employee involved in the management of the farm with a matrix of order 9, for which a questionnaire sent by email on December 16,

2021 was applied. Judgments of the employee and declarations of the manager, the variables competitors, intensity of rivalry among competitors, and substitute products were removed from the structuring of the problem due to their low importance in the farm's decision-making process, leaving six criteria and 12 alternatives (which correspond to the strategies adopted by the company to deal with the environmental variables that were identified in each criterion) for applying the method.

Thus, for the application of the AHP, the following steps were followed: selection of decision-makers (for this purpose, the farm owner's recommendation was followed); criteria establishments; identification of strategies; assignment of weights; and calculating the performance of each criterion and alternative.

Based on the interview and pre-test, for structuring the problem, only the following variables were used: clients, suppliers, government, society, natural environment, and potential entrants. As for the strategies, according to the actions practiced by the company, 12 strategies adopted to deal with the variables of the external environment were identified. They were: environmental certification (identified in the clients and society variables), building a positive image (clients and society), dissemination of good practices (society), fauna and flora inventory (society), hiring local labor (society), organization of cultural events to promote regional culture (society), selection of certified suppliers (suppliers), exclusivity contract with suppliers (suppliers), partnerships with environmental preservation bodies (government and environment), partnership with teaching institutions (government and environment), Farm School (environment, potential entrants), and endomarketing (entrants in potential). For a better visualization of the structure of the problem, a conceptual map is presented in Figure 2.



**Figure 2.** Structuring the problem

Source: Developed by the authors.



Once the hierarchy model was structured based on the AHP, the Saaty scale with nine points was presented, which allowed the evaluator to express the relative importance that one element has over the other according to her analysis. (Saaty, 1994)

The Saaty scale is a numerical scale composed of nine points, with 1 representing the indifference of importance that one criterion has about the other and 9 representing the extreme importance of one criterion compared to another, with intermediate stages between levels 1 to 9. Regarding the attribution of weights, the evaluator explained the Saaty scale and how the matrix works.

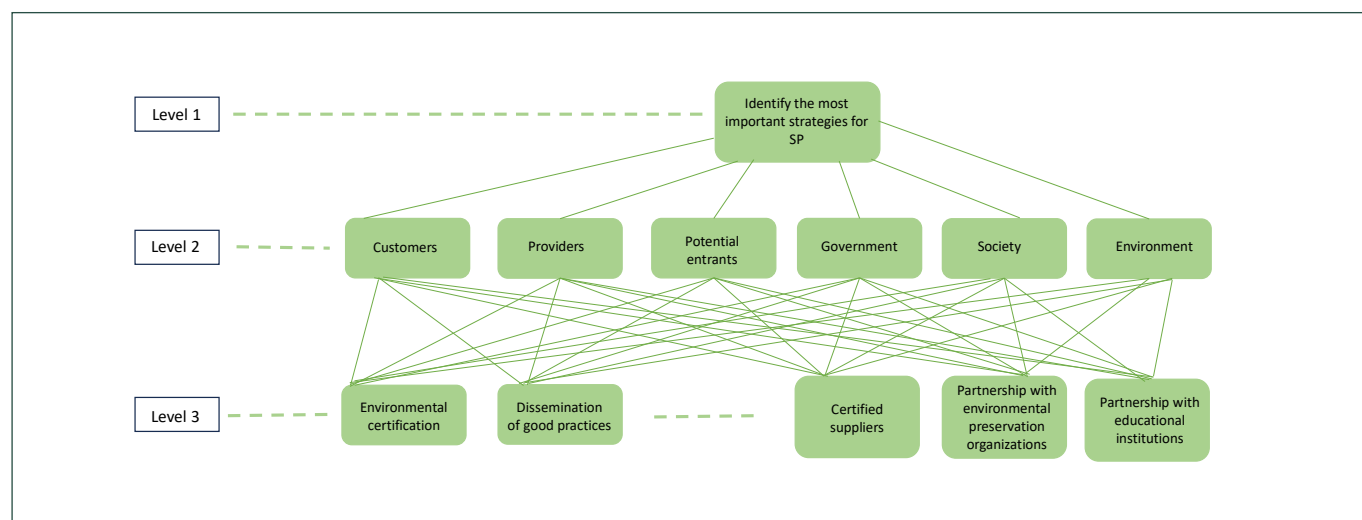
To reduce the possibility of inconsistencies in the evaluator's analyses, considering the limited availability of time and knowledge about this employee's method, the application of the AHP was carried out with a follow-up. Weights were assigned using a Microsoft Excel spreadsheet with comparison matrices.

Three meetings were held via the Google Meet platform, on March 23, 30, and April 6, 2022, lasting approximately 60 minutes each, in which the method was explained and pair-by-pair comparisons were requested.

During the process, the researcher shared Microsoft Excel spreadsheets online with the square matrix of criteria and alternatives based on the fundamental scale developed by Saaty (1991), on which the evaluator asked about the degree of importance of each paired element, and then the researcher fed the worksheet with the evaluator's consent. The evaluator carried out a pairwise comparison of the elements in each layer of the hierarchy, considering the connection between the elements of the layer immediately above.

### Application of the analytical hierarchy process model

In AHP model, the problem is structured following a three-level hierarchy, in which the objective must be the initial level, the criteria the second level, and the alternatives the third level. In complex cases, more levels can be added, such as sub-criteria. In building the hierarchy, it is important to clearly define all the elements and their relationships. Based on this perspective, the following problem hierarchy was formulated:



**Figure 3.** Hierarchical structure of the problem

Source: Developed by the authors.

According to the established hierarchy, level 1 is the objective of data collection or the multicriteria decision problem; level 2 criteria are the PEPSE model variables that were identified as the most important in the company's decision-making process according to the interview; and level 3 alternatives are the 12 strategies pointed out by the farm's production manager as the most important among the six variables of the PEPSE model adopted in the work. Thus, the research was carried out with a matrix of order six for criteria and six

matrices of order 12 for alternatives, considering only the strategies indicated in the respective criteria.

## FINDINGS AND DISCUSSION

### Analysis of criteria versus potential alternatives

Agricultural decision support systems (DSS) play an important role in the decision-making process in enterprises and each unit must customize its DSS according to its reality and concerns with production and commercial needs. Developing an agricultural DSS becomes challenging due to the variety of criteria to

be analyzed and applied to the multidimensional and regional nature needed to be considered in judgments and evaluations (Duan et al., 2021).

In the case of the PEPSE model, a survey of information about the company and the environment in which it operates is carried out to survey environmental strategies and diagnose sustainability. By combining PEPSE with AHP, it was possible to identify the

variables that are considered in the strategic planning of the farm, as well as the strategies that are adopted for its operation. Thus, initially, the evaluator was questioned about the weight of the importance of the criteria indicated in the survey as being considered in the treasury's decision-making process. Table 1 presents the degree of importance of each comparison between criteria.

**Table 1.** Criteria comparison matrix — criteria versus criteria comparison matrix.

	Customers	Providers	Government	Society	Environment	Potential entrants
Customers	1	1	3	2	1	9
Providers	1	1	3	2	0.5	8
Government	0.333333333	0.333333333	1	0.5	0.333333333	4
Society	0.5	0.5	2	1	1	8
Environment	1	2	3	1	1	9
Potential entrants	0.111111111	0.125	0.25	0.125	0.111111111	1
SUM	3.944444444	4.958333333	12.25	6.625	3.944444444	39

Note. Developed by the authors.

As can be seen, for the evaluator, the customers and natural environment criteria have the same degree of importance for decision-making, while the government and potential entrants criteria appear as the criteria of lesser weight compared to the other criteria. The evaluator's judgment reinforces the information obtained in the interview.

It is worth remembering that for the PEPSE model, the government variable influences the environment and society and acts on all other actors, however, for the production manager and evaluator, the government variable is less relevant compared to the variables society, suppliers, and the natural environment. The natural environment variable, on the other hand, acts on all actors in the model (customers, suppliers, substitute products, and potential entrants). It can thus be seen that both farm employees understand that the variables with the greatest impact on the decision-making process are those most related to the construction of the company's image (customers, suppliers, society, and the natural environment), except potential entrants, that according to Coral et al. (2003) is one of the variables that affect the company's image.

In this sense, it is understood that this perception of employees regarding the government variable is a reflection of the lack of support from the state for the development of local agriculture, especially concerning sustainability and financing. This conclusion is reinforced by the analysis of the potential entrants variable, which, as it does not directly influence the company's performance, was also considered of less-

er importance. As for the other criteria, it is suggested that the farm works together with the variables society, customers, suppliers, natural environment, and potential entrants as interdependent since they are directly linked to the construction of the image and positioning.

The analysis of the strategies adopted in the farm's strategic planning is based on the criteria that were followed. When comparing alternatives for the customers criterion, the environmental certification alternative has the greatest weight compared to the other alternatives, especially when compared to building a positive image, dissemination of good practices, cultural events, and partnership with higher education institutions. There is alignment between the information provided by the manager and the evaluator's analysis since environmental certification is the company's main objective and it is a differential to compete in the market. However, the weight attributed to the environmental certification alternative about the positive image building and dissemination of good practices alternatives for this criterion is noteworthy, since both alternatives are also related to market positioning and conquest.

According to the Secretary of Agriculture and Supply of the state of São Paulo (Secretaria da Agricultura e Abastecimento do Governo do Estado de São Paulo, 2010), good practices in agricultural activity are "one of the main instruments to demonstrate the proper management of a rural establishment, being a prerequisite of several protocols required by the internal and external market. It organizes production

activities and related records concerning obligations toward employees, government, and customers and rights vis-à-vis suppliers and service providers" (p. 1). The dissemination of good practices is one of the means for building a positive image with stakeholders. Building a good image is important both for winning the trust of customers, suppliers, and society, and for motivating employees. Thus, it is understood that the alternatives construction of a positive image and dissemination of good practices are inherent to the clients criterion, thus, it is believed that the discrepancy in the weights between them was due to the evaluator not having training for strategic management and, thus, not perceiving the relationship between them.

Comparisons based on the suppliers' criterion show that the alternatives cultural events, partnership with higher education institutions, Farm School, and endomarketing had a lower degree of importance than the others did. The most important variables were environmental certification, construction of a positive image, dissemination of good practices, and fauna and flora inventory.

The alternatives to which the evaluator attributed less importance are strategies indicated in the interview by the production manager, to deal with the variables society, government, natural environment, and potential entrants, respectively. The most important variables are pointed out by the production manager as being strategies aimed at the clients and society variables. In this way, the assessor's analysis, although somewhat distant from the production manager's speech, is perceived as coherent, since the alternatives with greater weight help strengthen the company's image and consequently the establishment of partnerships.

Brazilian agribusiness today faces a negative image in the domestic and foreign markets and this is largely due to negative socio-environmental impacts. Although the country is a reference in environmental legislation, especially in the last five years, government policies for environmental preservation have undergone drastic changes with an increase in deforestation and the occurrence of fires with the destruction of biomes such as those in the Amazon and Pantanal between 2019 and 2020 (Greenpeace Brazil, 2020). In addition, in this same period (between 2019 and 2020), around 343 pesticides and 400 pesticides were released by the government for use in agriculture (Brazil, 2020). Therefore, it is very important for companies in the sector to promote a positive image among their stakeholders, which is one of the main concerns for an establishment that seeks sustainable production.

As for the government variable, Bartzas and Komnitsas (2019) argue that measuring agricultural sustainability is challenging since it encompasses environmental and social criteria that, although often interconnected, are conflicting, making it difficult to achieve a simultaneous balance between them. For this reason, although many studies propose to measure agricultural sustainability, these evaluations are limited in terms of methodologies and tools. In the case of the farm, the biggest obstacle to sustainability today is the government and its environmental policies.

For the farm's production manager, the government's role in issuing certifications takes time. In addition, there is no incentive for sustainable production and support for the company's activity. Therefore, by understanding the government as an absent stakeholder, managers attribute little importance to this variable in their planning. However, regarding strategies, the highest weights attributed were environmental certification, inventory of fauna and flora, and partnership with public bodies of environmental preservation. These alternatives were indicated respectively in the variables clients and society, society and government, and natural environment. On the other hand, the lowest weights were attributed to the alternatives cultural events, endomarketing, and Farm School. Although the alternative partnership with higher education institutions was not indicated as a priority in the government criterion and the alternatives environmental certification and fauna and flora inventory were given priority, there is consistency in the evaluator's judgment, as the manager also reports that both variables are very important for the environmental preservation of the region and, consequently, have an impact on the relationship with the government. Another point worth mentioning was the little importance attributed to the Farm School alternative since environmental education has a great social role in raising awareness of the importance of environmental preservation. It should also be noted that the society, government, and environment criteria are interconnected.

As for the society criterion, according to Duan et al. (2021), the social dimension in agribusiness must consider the health and well-being of the community and employees. However, most of the developed studies consider the criteria related to habitat in the social dimension (Yuan et al., 2022). For the farm, society is part of the organization's ecosystem, essential for its existence and development. In addition, the farm's sustainability involves environmental education

and joint work with the community for industrial production and preservation in the surroundings.

In the survey, the highest weights for this dimension were assigned to the alternatives environmental certification, construction of a positive image, dissemination of good practices, hiring local labor, inventory of fauna and flora, and organization of cultural events, respectively. All alternatives were mentioned by the production manager as strategies to deal with the society variable. The alternatives with the lowest weights were Farm School, endomarketing, and partnership with higher education institutions, respectively. Such alternatives were cited as strategies in the variables' natural environment, potential entrants, and government.

It is noticed that in the matrix directed to the society criterion there is a certain balance in the importance attributed to each alternative, without major differences between them, except for the cultural events alternative, with lower priority. In this matrix, all the alternatives mentioned in the interview with the production manager as strategies for the society variable were given priority over the other alternatives, confirming the alignment of the information provided between the production manager and the evaluator. It should be noted that for the PEPSE model, the society variable is seen as a competitive force that acts especially about the image of the company and its suppliers, who must act in a socially responsible manner. For [Coral et al. \(2003\)](#), this variable directly influences competitiveness. For this criterion, qualitative data collection followed the proposal by Coral, who recommends analyzing the company's interaction with the environment and society, to identify the market niche and its role in the social development of the region.

Based on the strategies raised in the interview with the production manager, it seems that society is the variable with the most strategies adopted in the SP, and from the analysis of the alternatives carried out by the evaluator, it was found that, in line with the model, except for the Farm School alternative — which is a strategy related to communication with the community, but was not considered a priority for the society criterion by any of the interviewees —, all the other strategies of greater importance fulfill the communication with the other external actors from the farm. From the results, the alternatives certified suppliers and exclusivity agreement with certified suppliers are not seen by the farm as a strategy for the relationship with society, thus, it is recommended to the farm to deal with the alternatives Farm School, suppliers certificates, and exclusivity contracts with certified sup-

pliers as members of the decision-making process regarding the society variable.

For the natural environment criterion, the greatest importance occurs concerning the alternatives environmental certification, inventory of fauna and flora, construction of a positive image, and dissemination of good practices, respectively. None of the mentioned variables was mentioned in the interview with the production manager as strategies to deal with the variable but in the clients and society variables. The lower values from the side of the evaluator are the Farm School, partnerships with higher education institutions, and cultural events. Both alternatives, Farm School and partnership with higher education institutions, were indicated as strategies in the government variable by the production manager, thus being yet another matrix in which the employees' responses diverged.

It is worth mentioning that for the PEPSE model, the environment, as well as society, is considered one of the competitive forces. For [Coral et al. \(2003\)](#), when concern for the environment integrates with the corporate identity, it will not only channel the necessary resources for decision-making but also provide a political foundation to justify and legitimize business commitments. Therefore, although there were divergences between the two research participants, the attribution of weights followed the same analysis criteria for this variable recommended in the PEPSE model, which indicates the company's policy regarding the environment, market demand for certifications, the image of the company, environmental preservation projects, communication with the community, and environmentally correct production, as variables to evaluate the environment as stakeholders ([Coral et al., 2003](#)).

Although the farm's employees are not familiar with the PEPSE model, empirically the model's principles are already applied in the organization, which is evidenced by the alternatives identified as priorities and the strategies indicated throughout the interview with the production manager. Thus, even if the strategies indicated by the manager as being applied for the environmental analysis in the interview were different from the priorities pointed out by the evaluator — which may even occur due to the conduct of the interview by the researcher —, the alternatives environmental certification, inventory of fauna and flora, building a positive image, and disseminating good practices are intrinsically related to the farm's environmental practices and its sustainability.

Finally, the most important potential entrants occurred for the alternatives environmental certification,

construction of a positive image, and dissemination of good practices, cited as strategies in the customers and society variables. The less important variables were partnerships with higher education institutions, Farm School, and endomarketing, alternatives cited as strategies for the variables government, natural environment, and potential entrants. According to the allocation of weights, this criterion repeats the same divergence between the allocation of weights and information provided in the interview found in the matrix for the criterion government, suppliers, and natural environment, which may have happened due to the weight of priorities being different from the business vision. The AHP is a method that helps identify these problems since the matrix generated and the allocation of weights represent a living document and can indicate that the decision-making manager and the executing manager may have different views on priorities. Thus, it is recommended that the company review the organization's priority in terms of deciding where to allocate resources or reorganizing priorities.

Based on the attribution of weights, it was possible to identify that even if the company did not adopt a specific SP model, it had clear and well-established strategies for the enterprise. It was also possible to perceive the suitability of the PEPSE model as a strategic planning tool for the company's reality and profile. When comparing the information obtained in the interview with the production manager and the attribution of weights by the company's public relations, even though they occupy positions and play different roles in the organization, both converge on many points about the organizational reality and priorities in the face of the decision-making process. Thus, it is understood that although there have been some divergences regarding the alternatives in each criterion (or strategies adopted for each variable that the company considers), in general, the vision of both coincides. As for the divergences, these may have occurred due to the conduct of the interview and even the training of the two professionals participating in the research.

About the external analysis of the organization, [Coral et al. \(2003\)](#) point out that this aims to identify the competitive forces that act on the company and its positioning in the market. In the PEPSE model, society and the environment are actors that can influence competition and competitiveness in an industry, especially when it seeks sustainability. The inclusion of these actors as stakeholders can help identify new opportunities, as well as analyze existing risks in the relationship between the company and its stakeholders.

Several studies have been developed over the years addressing sustainability in agribusiness from the application of the multicriteria decision, regarding the works developed by [Bartzas and Komnitsas \(2019\)](#) and [Yuan et al. \(2022\)](#). The study in question was concerned with applying the AHP associated with the strategic planning model for corporate sustainability, which in turn was elaborated from Porter's competitive forces, traditional models of strategic planning, and models of sustainable strategies already validated in the literature. Based on the proposed model and criteria, an interview was applied with the manager of the investigated farm to validate the model and identify which criteria are important in the decision of a sustainable and environmentally certified farm.

This time, based on the matrices obtained, the company considers as priority criteria the variables customers, natural environment, and suppliers and assigns less importance to government and potential entrants. It was seen in the interview that the reason why these two variables are less important is due to the low level of participation of the government in the performance of the farm and because it often delays the certification processes and environmental projects of the farm. Based on the production manager's perception and the evaluator's analysis, although the company focuses on sustainability and environmental projects for the sustainable development of the region, customers and the environment are of equal importance in its decision-making process, which is very consistent for a profit-making organization, since customers are the main reason for the existence of enterprises. It also confirms the importance of the environment for the farm's business.

As for the analysis of the alternatives, it was seen that although there were differences between the perceptions of the production manager and the evaluator, for all criteria the alternatives that were presented as priorities were consistent with the judged criteria and the reality of the farm. Based on the results of the matrix of alternatives, environmental certification is confirmed as the focus of the company's planning, since it is the main strategy for differentiation and positioning in a growing market. Once the relative priorities are obtained, and the consistency of the results was satisfactory, it is necessary to combine the comparison matrices of the alternatives with the matrix of the importance of the criteria. Thus, we can understand, among the alternatives, which are priorities for the organization. This combination was realized using the geometric mean method of the values obtained in the priority vectors for each criterion, thus constructing the ranking matrix, making it pos-



sible, through the mean value, to obtain the relative priority of each alternative according to the analysis carried out. Table 2 presents the performance of each alternative given the criteria used in the research.

In this way, six matrices of judgments are organized and, for each one of them, the Relative Priority and the Weight Vector were determined. Thus, because of the judgments, it was possible to prioritize alternatives according to their performance (Table 3).

It is common for a decision-making process to have multiple objectives. For these situations, the heuristic is used to promote the hierarchy of an alternative over the others. In the multicriteria decision, the most used methods for this purpose are AHP and TOPSIS (Brentan et al., 2021). Although the geometric mean method is commonly applied for group decisions, since it is a more complex and robust method, it was chosen for application at work because it is a more accurate method.

**Table 2.** Performance of alternatives against the criteria

	Result of alternatives by criteria						RELATIVE PRIORITY (Weighted average)	PRIORITIES VECTOR
	Customers	Providers	Government	Society	Environment	Potential entrants		
Environmental certification	0.229702	0.279623715	0.200875528	0.186125145	0.169087876	0.189108345	0.206165416	0.216913828
Building a positive image	0.050948	0.126928827	0.072591564	0.156511967	0.116840835	0.166107857	0.106092422	0.111623538
Disclosure of good practices	0.053814	0.150944664	0.064040067	0.145500096	0.116840835	0.141671186	0.103828761	0.109241862
Fauna and flora inventory	0.131508	0.099224404	0.129918641	0.102226377	0.149168833	0.077964658	0.112390685	0.118250161
Local labor hiring	0.071739	0.05574025	0.11092065	0.132058831	0.074654646	0.097702434	0.086784974	0.091309499
Cultural events	0.029998	0.018562251	0.022541344	0.062783522	0.041084035	0.02126527	0.029715432	0.031264643
Certified suppliers	0.110585	0.060876772	0.100228122	0.043576751	0.071159636	0.073588838	0.073210418	0.077027235
Exclusivity agreement with suppliers	0.083292	0.046712597	0.038884333	0.036162399	0.050094695	0.070143724	0.051757677	0.054456057
Partnership with environmental preservation organizations	0.043265	0.057966744	0.133208708	0.048600551	0.077483371	0.051526926	0.063380356	0.066684684
Partnership with educational institutions	0.022618	0.024156231	0.05619293	0.033403168	0.033320653	0.030638094	0.031865471	0.033526774
Farm school	0.07348	0.030038726	0.041321557	0.021691914	0.035964595	0.038982329	0.037483874	0.039438092
Endomarketing	0.099051	0.049224818	0.029276557	0.031359281	0.06429999	0.041300339	0.047772988	0.050263627
<b>TOTAL RESULT</b>							0.950448473	1

Note. Developed by the authors.

**Table 3.** Final evaluation and ranking of alternatives.

Alternatives	General ranking of alternatives	
	Final evaluation	Classification
Environmental certification	0.206165416	1
Fauna and flora inventory	0.106092422	2
Building a positive image	0.103828761	3
Disclosure of good practices	0.112390685	4
Local labor hiring	0.086784974	5
Certified suppliers	0.029715432	6
Partnership with environmental preservation organizations	0.073210418	7
Exclusivity agreement with suppliers	0.051757677	8
Endomarketing	0.063380356	9
Farm school	0.031865471	10
Partnership with educational institutions	0.037483874	11
Cultural events	0.047772988	12

Note. Developed by the authors.

From the classification of the alternatives, the following strategies are identified as priorities for the SP of the farm: environmental certification, inventory of fauna and flora, construction of the positive image, dissemination of good practices, and hiring of local labor, respectively. These strategies are essential for dealing with the project's stakeholders.

## CONCLUSION AND FURTHER REFLECTIONS

Given the initial objectives of this research, we realized that the priority criteria in the strategic planning of the farm are clients and the natural environment. Fazenda Tamanduá is a reference in organic and biodynamic production, in addition to being a model of sustainability for the agricultural sector. For an organization that prioritizes sustainable development as a business model, we understand that prioritizing customers — the reason for the existence of for-profit organizations — and the environment in the decision-making process is the right way to consolidate itself in an increasingly conscious market and demand in terms of environmental issues.

Regarding priority strategies, the farm has prioritized environmental certification, through which it confirms its sustainable practices with its stakeholders, including the fauna and flora inventory, through which it is possible to verify the positive or negative impacts of its practices. In the case of Fazenda Tamanduá, the inventory has shown, through cataloging, the appearance and increase in the population of native species in the region; and construction of a positive image and dissemination of good practices, which are important strategies for the company's positioning and competitiveness, followed by hiring local labor. The association of the image of Brazilian agribusiness with terrible working conditions and negative social impacts was mentioned throughout the paper. It is necessary to comply with labor legislation, as well as to promote positive people management practices, in addition to retaining motivated personnel with a profile suited to the company's needs.

Although the PEPSE model was applied in the study only to identify external analysis variables for a business to promote sustainability, the adequacy of the model to the farm's profile was verified. It is a tool option to be adopted, since the farm does not have a structured SP necessary for better business management.

As recommendations for the farm, it is indicated the adoption of an NP model that assists in the strategic diagnosis of the farm and its management practices of sustainability. It also helps in: (1) definition of

the farm's hierarchical structure for a better division and organization of work since decisions are centralized in a single person; (2) planning meetings with the team to align understandings on decision priorities and business vision; and (3) promoting training with the team involved on PE and the importance of periodically carrying out a strategic diagnosis of the business to analyze the company's relations with its stakeholders.

The finding provided insight into the environmental variables that influence the region's agricultural sector and are opportunities or limiters of organizational action. From the research, it is possible to identify a promising path for developing sustainable agriculture in Brazil. However, the movement of the local government and at the state and federal level need to provide assistance and even demand more actively the responsible action of the rural units.

Farming is essential to ensure the food security of the population; however, in addition to producing food in quantity, food security also involves the safe production and good quality of these foods. With this, the study contributions shed light on the importance of sustainable production and the implications show that it is possible to make a profit and act responsibly toward the environment and society while seeking to provide companies in the sector with a viable path for the adoption of corporate sustainability.

As for research limitations, the COVID-19 pandemic was the main obstacle encountered in the development of the study. Due to the adoption of sanitary measures and the reduction of personnel on the farm, as well as restrictions on visitation, contact with employees was very difficult and directly compromised data collection. At first, it was intended to interview the manager and the owner and carry out the application for the AHP with the farm's production manager. However, it was not possible to contact the owner for data collection and in the AHP phase, the production manager was also unavailable, making it necessary to finalize the research with the company's public relations, which, although it presented a holistic and in-depth view of the business, does not participate directly in the management and decision-making process.

As suggestions for future work, we recommend analyzing the internal environment to understand more deeply how the company's strategies are established and how the decision-making process is organized to understand how the farm management process occurs. Another recommendation is to realize a strategic diagnosis of the farm with a group decision involving the production manager and the business owner.

## REFERENCES

- Agudelo, M. A., Jóhannsdóttir, L., & Davídsdóttir, B. (2019). A literature review of the history and evolution of corporate social responsibility. *International Journal of Corporate Social Responsibility*, 4(1), 1-23. <https://doi.org/10.1186/s40991-018-0039-y>
- Bartzas, G., & Kornitsas, K. (2019). An integrated multi-criteria analysis for assessing sustainability of agricultural production at regional level. *Information Processing in Agriculture*, 7, 223-232. <https://doi.org/10.1016/j.inpa.2019.09.005>
- Brazil (2020). Act no. 31, from May 4, 2020. O Coordenador-Geral de Agrotóxicos e Afins no uso das suas atribuições legais resolve dar publicidade ao resumo dos registros de agrotóxicos e afins concedidos, conforme previsto no Artigo 14 do Decreto nº 4074, de 04 de janeiro de 2002. Ministério da Agricultura, Pecuária e Abastecimento. *Diário Oficial da União*. [https://www.abcsem.com.br/upload/arquivos/ATO\\_N%C2%BA\\_31%C2%DE\\_4\\_DE\\_MAIO\\_DE\\_2020.pdf](https://www.abcsem.com.br/upload/arquivos/ATO_N%C2%BA_31%C2%DE_4_DE_MAIO_DE_2020.pdf)
- Brentan, B. M., Carpitella, S., Izquierdo, J., Luvizotto, E., Jr., & Meirelles, G. (2021). District metered area design through multi-criteria and multi-objective optimization. *Mathematical Methods in the Applied Sciences*, 45(8), 1-18. <https://doi.org/10.1002/mma.7090>
- Carroll, A. B. (2015). Corporate social responsibility: The centerpiece of competing and complementary frameworks. *Organizational Dynamics*, 44(2), 87-96. <https://doi.org/10.1016/j.orgdyn.2015.02.002>
- Chuma, G. B., Mondo, J. M., Karume, K., Mushagalusa, G. N., & Schmitz, S. (2021). Factors driving utilization patterns of marshlands in the vicinity of South-Kivu urban agglomerations based on Rapid Assessment of Wetland Ecosystem Services (RAWES). *Environmental Challenges*, 5, 1-15. <https://doi.org/10.1016/j.envc.2021.100297>
- Cohen, D., Nelson, S., & Rosenman, E. (2021). Reparative accumulation? Financial risk and investment across socio-environmental crises. *Environment and Planning E: Nature and Space*, 5(4) 2356-2382. <https://doi.org/10.1177/25148486211030432>
- Coral, E. (2002). *Modelo de planejamento estratégico para a sustentabilidade empresarial* [Doctoral Dissertation, Universidade de Santa Catarina]. UFSC Repository <https://repositorio.ufsc.br/bitstream/handle/123456789/82705/189235.pdf?sequence>
- Coral, E., Rossetto, C. R., & Selig, P. M. (2003). O planejamento estratégico e a formulação de estratégias econômicas, sociais e ambientais: Uma proposta em busca da sustentabilidade Empresarial. *Iberoamerican Academy of Management International Conference*. São Paulo, Brazil. [http://www.fgvsp.br/iberoamerican/Papers/0306\\_Artigo%20Iberoamerican%20-20PEPSE.pdf](http://www.fgvsp.br/iberoamerican/Papers/0306_Artigo%20Iberoamerican%20-20PEPSE.pdf)
- Duan, S. X., Wibowo, S., & Chong, J. (2021). A multicriteria analysis approach for evaluating the performance of agriculture decision support systems for sustainable agribusiness. *Mathematics*, 9(8), 884. <https://doi.org/10.3390/math9080884>
- Faria-Schützer, D. B. D., Surita, F. G., Alves, V. L. P., Bastos, R. A., Campos, C. J. G., & Turato, E. R. (2021). Seven steps for qualitative treatment in health research: The clinical-qualitative content analysis. *Ciência & Saúde Coletiva*, 26(1), 265-274. <https://doi.org/10.1590/1413-81232020261.07622019>
- Greenpeace Brazil. (2020). Brasil em chamas: Do Pantanal à Amazônia, a destruição não conhece fronteiras. *Greenpeace Brasil*. <https://www.greenpeace.org/brasil/blog/brasil-em-chamas-negando-as-aparencias-e-disfarcando-asevidencias/>
- Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, 20(4), 986-1014. <https://doi.org/10.2307/258963>
- Hart, S. L. (1997). Strategies for a sustainable world. *Harvard Business Review*, 75(1), 66-76. <https://hbr.org/1997/01/beyond-greening-strategies-for-a-sustainableworld>
- Hill, M. J., Braaten, R., Veitch, S. M., Lees, B. G., & Sharma, S. (2005). Multi-criteria decision analysis in spatial decision support: The ASSESS analytic hierarchy process and the role of quantitative methods and spatially explicit analysis. *Environmental Modelling & Software*, 20(7), 955-976. <https://doi.org/10.1016/j.envsoft.2004.04.014>
- Ishak, A., Asfiryati, & Akmaliah, V. (2019). Analytical Hierarchy Process and PROMETHEE as decision making tool: A review. *IOP Conference Series: Materials Science and Engineering*. Series: Materials Science and Engineering, 505, 012085. <https://doi.org/10.1088/1757-899X/505/1/012085>
- Lahti, T., Wincet, J., & Parida, V. (2018). A definition and theoretical review of the circular economy, value creation, and sustainable business models: Where are we now and where should research move in the future? *Sustainability*, 10(8), 2799. <https://doi.org/10.3390/su10082799>
- Ministry of Agriculture and Livestock. (2023). Valor Bruto da Produção Agropecuária de 2023 é estimado em R\$ 1,216 trilhão. <https://www.gov.br/agricultura/pt-br/assuntos/noticias/valor-bruto-da-producao-agropecuaria-de-2023-e-estimado-em-r-1-216-trilhao#:~:text=O%20Valor%20Bruto%20da%20Produ%C3%A7%C3%A3o,foi%20de%20R%24%201%2C161%20trilh%C3%A3o>
- Montgomery, D. R. (2018). *Growing a revolution: Bringing our soil back to life*. W. W. Norton & Company.
- Nosratabadi, S., Mosavi, A., & Shamshirband, S. (2019). Sustainable business models: A review. *Sustainability*, 11(6), 1663. <https://doi.org/10.3390/su11061663>
- Opoku, D. G. J., Perera, S., Osei-Kyei, R., & Rashidi, M. (2021). Digital twin application in the construction industry: A literature review. *Journal of Building Engineering*, 40, 102726. <https://doi.org/10.1016/j.jobe.2021.102726>
- Porter, M. E. (2008). *Competitive strategy: Techniques for analyzing industries and competitors*. Simon and Schuster.
- Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: In search of conceptual origins. *Sustainability Science*, 14, 681-695. <https://doi.org/10.1007/s11625-018-0627-5>
- Ruiz, A. E. T. (2021). El transitar en la investigación cualitativa: Un acercamiento a la triangulación. *Revista Científica*, 6(20), 275-295. <https://doi.org/10.29394/Scientific.issn.2542-29872021.6.20.15.275-295>
- Reinhardt, F. L. (1999). Bringing the environment down to Earth. *Harvard Business Review*, 77(4), 149-157. <https://hbr.org/1999/07/bringing-the-environment-down-to-earth>
- Reuters. (2020, June 19). Investidores europeus ameaçam desinvestir no Brasil devido a desmatamento. G1. <https://g1.globo.com/economia/noticia/2020/06/19/investidores-europeus-ameacam-desinvestir-no-brasil-devido-a-desmatamento.ghml>
- Rose, D. D. (2008). Interventions to reduce household food insecurity: A synthesis of current concepts and approaches for Latin America. *Revista de Nutrição*, 21(Suppl.), 159-173. <https://doi.org/10.1590/S1415-52732008000700014>
- Saaty, T. L. (1991). *Método de análise hierárquica* (W. da Silveira e Silva, Transl.). McGraw-Hill.
- Saaty, T. L. (1994). How to make a decision: The Analytic Hierarchy Process. *Interfaces*, 24(6), 19-43. <https://doi.org/10.1287/inte.24.6.19>
- Saaty, T. L., & Vargas, L. G. (2012). The seven pillars of the Analytic Hierarchy Process. In T. L. Saaty, & L. G. Vargas (Eds.), *Models, methods, concepts and applications on the Analytic Hierarchy Process* (pp. 23-40). Springer. [https://doi.org/10.1007/978-1-4614-3597-6\\_2](https://doi.org/10.1007/978-1-4614-3597-6_2)
- Sari, F., Caylan, D. A., Özcan, M. M., & Özcan, M. M. (2020). A comparison of multicriteria decision analysis techniques for determining beekeeping suitability. *Apidologie*, 51, 481-498. <https://doi.org/10.1007/s13592-020-00736-7>
- Secretaria da Agricultura e Abastecimento do Governo do Estado de São Paulo. (2010). Boas Práticas Agropecuárias: Um guia para pequenos e médios produtores do estado de São Paulo. Coordenadoria de Assistência Técnica Integral, Fundo de Expansão do Agronegócio Paulista. <https://www.defesa.agricultura.sp.gov.br/www/servicos/getpdf.php?idform=984>
- Sharma, S. (2000). Managerial interpretations and organizational context as predictors of environmental strategy. *Academy of Management Journal*, 43(4), 681-697. <https://doi.org/10.2307/1556361>
- Shrivastava, P. (1995). The role of corporations in achieving ecological sustainability. *Academy of Management Review*, 20(4), 936-960. <https://doi.org/10.2307/258961>
- Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333-339. <https://doi.org/10.1016/j.jbusres.2019.07.039>
- Söderholm, P. (2020). The green economy transition: The challenges of technological change for Sustainability. *Sustainable Earth*, 3(6), 2-11. <https://doi.org/10.1186/s42055-020-00029-y>
- Stead, J. G. & Stead, E. (2000). Eco-enterprise strategy: Standing for Sustainability. *Journal of Business Ethics*, 24, 313-329. <https://doi.org/10.1023/A:1006188725928>
- Timans, R., Wouters, P., & Heilbron, J. (2019). Mixed methods research: What it is and what it could be. *Theory and Society*, 48, 193-216. <https://doi.org/10.1007/s11186-019-09345-5>
- Yuan, Z., Wen, B., He, C., Zhou, J., Zhou, Z., & Xu, F. (2022). Application of multi-criteria decision-making analysis to rural spatial sustainability evaluation: A systematic review. *International Journal of Environmental Research Public Health*, 19(6572), 1-31. <https://doi.org/10.3390/ijerph19116572>

---

## Authors

**Najara Escarião Agripino** 

Universidade Federal de Campina Grande  
R. Aprício Veloso, 882 Universitário, CEP 58701-030, Campina Grande, PB,  
Brazil.  
najaraagripino@gmail.com

**Kettrin Farias Bem Maracajá** 

Universidade Federal de Campina Grande  
R. Aprício Veloso, 882 Universitário, CEP 58701-030, Campina Grande, PB,  
Brazil  
kettrin@gmail.com

**André C. S. Batalhão** 

NOVA University Lisbon School of Science and Technology  
Largo da Torre, CEP 2829-516, Caparica, Portugal  
andre.ciamb.ufg@gmail.com

## Authors' contributions

**1<sup>st</sup> author:** conceptualization (lead), data curation (lead), formal analysis (lead), investigation (lead), methodology (lead), project administration (supporting), validation (lead), writing – original draft (lead).

**2<sup>nd</sup> author:** conceptualization (supporting), data curation (supporting), formal analysis (supporting), investigation (supporting), methodology (supporting), project administration (lead), supervision (lead), validation (lead), visualization (supporting), writing – original draft (lead), writing – review & editing (lead).

**3<sup>rd</sup> author:** conceptualization (supporting), formal analysis (supporting), visualization (supporting), writing – review & editing (supporting)