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SUSTAINABILITY DIMENSIONS DRIVEN BY SOCIO-ENVIRONMENTAL PRACTICES IN ORGANIC CERTIFICATION: AMAZONIAN AÇAÍ BERRY CASE

Mariana da Silva Cavalcante[1] | Cyntia Meireles Martins[2]
Susana Carla Farias Pereira[3] | Márcia Regina Santiago Scarpin[4]
Sérgio Castro Gomes[5]

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[1] DMaster in Administration (UNAMA).
Castanhal - PA, Brazil.
E-mail: marian4_cavalcant3@hotmail.com

[2] PhD in Agricultural Sciences (UFRA).
Professor at the Federal Rural University of the Amazon.
Belém - PA, Brazil.
E-mail: cyntiamei@hotmail.com

[3] PhD in Business Administration (FGV).
Professor at the Getúlio Vargas Foundation.
São Paulo - SP, Brazil.
E-mail: Susana.Pereira@fgv.br

[4] PhD in Business Administration.
Professor at the Concordia College.
Moorhead - Minnesota, EUA.
E-mail: msantiag@cord.edu

[5] PhD in Applied Economics (FGV).
Professor at the University of the Amazon.
Belém - PA, Brazil.
E-mail: sergio.gomes@unama.br

ABSTRACT

This research aims to identify the sustainability dimensions driven by socio-environmental practices in organic certification, and the impact of these practices on the operational performance of the dyad, agro-industry and extractivist farmers. The sustainable supply chain management literature was used to support the sustainability dimensions, identified through the socio-environmental criteria present in the implementation of organic certification, which meets both government legal requirements and customer pressure. Our sample is composed of 206 questionnaires. Exploratory Factor Analysis and Multiple Regression were used for data analysis and representation. Organic certification for extractivist açaí berry farmers is represented by four sustainability dimensions generated from factor analysis of the practices: sustainable natural resources; sustainable human resources; sustainable awareness; and sustainable regulation. All the dimensions had a positive, significant relationship with operational performance, the greatest impact being on sustainable human resources. This paper contributes to the literature on sustainable supply chains in four aspects. First, it considers the role of training human resources, which is still at an early stage. Second, it presents the sustainability dimensions based on the demands of customers and the government. Third, by advancing the discussion about the importance of certification, in our case organic agri-food, it aims at implementation of sustainable practices, mainly for small suppliers run by families with difficult geographic access, such as those in our research. Fourth, it emphasizes the importance of the dyad relationship in developing sustainable suppliers.

Keywords: Organic Certification; Social and Environmental Practices; Sustainable Management; Relationship; SDS 2.

INTRODUCTION

The organic food chain still faces sustainability challenges since it mainly comprises small farmers, who often have limited resources and experience difficulties when it comes to selling their produce (Medaets; Fornazier; Thomé, 2020). Organic certification involving small farmers is a set of socio-environmental practices that are attested by organic and fair-trade seals, and are implemented through the relationships formed between small farmers and large scale agri-business enterprises (Silva; Dias; Gold, 2021).

Customers who consume organic products value the origin and quality of food, and are in favor of better remuneration for these farmers. They are also concerned about environmental conservation (Souza *et al.*, 2021). Customer pressure can have an impact on the adoption of sustainable practices (Ehrgott *et al.*, 2011; Martins *et al.,* 2024), and the debate at government level.

Kitsis and Chen (2021) showed that there are positive effects of sustainable practices based on demanding criteria from stakeholders, such as those customers and the government exert on operational performance. The field of action of external agents (e.g. customers and government) is an important path of research into sustainability (Oftedal *et al*., 2021).

Studies examining organic certification, however, are still at a very early stage in their development, and the way in which sustainability is disseminated, its patterns and impact on operational performance need to be analyzed in order to expand the field of knowledge; this is an important agenda for research (Silva; Dias; Gold, 2021).

Ibanez and Blackman (2016) stressed the need for more quantitative studies with evidence coming from the contexts researched, in order to draw general conclusions about the circumstances in which organic certification generates socio-environmental and economic benefits. The research by Zaridis, Vlachos and Bourlakis (2020) showed that, by developing collaborative capabilities and aligning them with company strategy, the performance of food systems can be improved. They also emphasized the need for future studies on food supply chains, which should be examined in other regions, in order to assess whether there are country-specific effects, as well as verify their institutional role and context.

Silva, Dias and Gold (2021) emphasized that the dissemination of sustainability standards in supply chains is directly linked to the governance mechanism (relationship) assumed by a company for organic and fair-trade seals. In this sense, relationships seem to be more suitable for spreading sustainability practices between buyers and suppliers, which, under government and customer criteria, define the sustainability dimensions that most substantially help companies to sustainably manage their supply chains.

In the case of this research, the sustainability dimensions are guided by organic certification. These can be seen as imitable, easily transferable practices in the supply chain, that is, they extend among its members, and, therefore, can lead to better operational performance (Carter; Kosmol; Kaufmann, 2017; Kirchoff; Falasca, 2022). We adopted recommendations for the sustainable management of supply chains, using a theoretical approach based on a broader perspective (Seuring; Müller, 2008) of the relationship of a dyad buyer-supplier.

This work involves the dyad by way of the Amazonian açaí berry agro-industry and extractive farmer relationship, which helps to consolidate the field of sustainability studies in the context of emerging countries (Silva; Pereira; Gold, 2018). Especially in the Brazilian Amazon region, given its socio-environmental peculiarities, we stress its great sustainability challenge, because, in addition to being the largest tropical forest in the world, it is a supplier of agricultural products, timber, provides ecosystem services, features climatic concerns, and is governed by conservation regulations to protect the greatest biodiversity on the planet. On the other hand, in terms of social aspects, the Amazon is home to more than 30 million people, many of whose basic social needs have not yet been met, such as sanitation (Fernandes; Sousa-Filho; Viana, 2021).

This outline is important because research into the sustainable management of supply chains, according to Oftedal *et al*. (2021), need advance in the approaches whose operationalization, analysis, discussion and results involve social aspects.

The results of our paper lead us to reflect on the development of suppliers through collaboration and training for sustainability, especially in the context of small extractivist producers in the Amazon, thus contributing to the sustainable management of regional chains.

Therefore, our research proposes to answer the following research question: Which sustainability dimensions of organic certification have an impact on operational performance based on the small farmer relationship with the açaí agro-industry in the context of the Brazilian Amazon region? This research aims to identify the sustainability dimensions driven by socio-environmental practices in organic certification, and the impact of these practices on the operational performance of the dyad, agro-industry and extractivist farmers.

SUSTAINABLE MANAGEMENT OF SUPPLY CHAINS AND ORGANIC CERTIFICATION

Sustainable management of supply chains is conceptualized as strategic, transparent, integrated thinking to achieve sustainable development goals in systemic coordination of inter-organizational business processes that derive from customers and other agents in the chain (Seuring; Müller, 2008). As a result, it includes social, environmental and economic performance (Elkington, 2001; Danese; Lion; Vinelli, 2019). In recent years, it has been gaining importance in academia, organizations and regulatory agencies (Grimm; Hofstetter; Sarkis, 2016).

Seuring and Müller (2008) stated that joint initiatives involving a company and its suppliers may be essential for setting up a supply chain that is oriented toward sustainable products. Companies normally develop their suppliers by using their own resources to market products with the specifics they require. Integration and the flow of information tend to be intense in the sustainable supply chain to identify the improvements needed at each stage of production, and apply them throughout the chain links to the end customer.

In many cases, the intensification of supplier assessment and monitoring activities result in overall performance improvement of the chain, although this is still largely restricted to economic and environmental criteria (Seuring; Müller, 2008). Pagell and Wu (2009) argued that there is a possibility of focal companies and other members in the chain having outstandingly better economic, environmental and social performance results, provided that sustainability practices are aligned with strategies based on internal and external drivers and rewards. The study by Silvestre (2016) revealed that economics and market opportunities are the great motivators that encourage supply chain managers to adopt sustainability in their operations.

The work by Fernandes, Sousa-Filho and Viana (2021) emphasized the importance of a collaborative relationship between companies, government and socio-economic actors in challenging contexts, as in the case of the Amazon, in such a way as to generate impacts that are associated with the social, economic and environmental sustainability dimensions. Therefore, regular joint initiatives between the company and its suppliers can be essential for implementing a supply chain that is oriented toward sustainable products (Magon *et al*., 2018). The incorporation of sustainable practices may also mitigate environmental impacts and improve local social conditions (Paiva *et al*., 2015).

Non-governmental organizations (NGOs), customers and governments have pressured companies to implement socio-environmental criteria in their supply chains (Grimm; Hofstetter; Sarkis, 2016), and when companies are subject to legal pressure, they tend to pass them on to their suppliers (Martins *et al.* 2024). To ensure compliance with sustainability criteria, collaboration and monitoring working together aim to increase the performance of the dyad's processes and products (Danese; Lion; Vinelli, 2019).

In the case of organic certification, according to Lima, Neutzling and Gomes (2021), there is an open debate about sustainability, and the need to research the institutionalization of organic standards is also being considered. These authors point out, however, that certification can help supply chains face challenges and promote sustainable food systems by involving the farmers (Lima; Neutzling; Gomes, 2021). Corroborating Silva, Dias and Gold (2021), they found a close relationship between the governance mechanisms (relationships) of organic certification and the dissemination of sustainability.

Haggar *et al.* (2017) also found that organic and fair-trade certification, for example, promoted better environmental performance, and was of some economic benefit to certified farms when compared to uncertified ones. Donovan and Poole (2014) concluded that organic and fair-trade certification of coffee in Nicaragua achieved a broader set of results than just access to favorable prices. Thus, their cooperatives became economically sustainable. Some family farms with limited resources also benefited from the construction of specific assets, such as natural capital, human capital, social capital, and physical and financial capital. The research by Souza *et al*. (2017) confirmed that, when cooperatives in Pará State adopted the certification process for the fair-trade market, this promoted sustainable practices in the organization.

Here, the concept of territory is useful for thinking about regional development strategies, especially in territorial contexts with socio-economic weaknesses. For Denardin *et al.* (2022, p. 65), the territory is "an active unit of development, which possesses unique resources that cannot be transferred from one region to another". Valuing the territory's resources through the market, prioritizing practices aimed at cooperation, and encouraging trust among the players, can enable generation of work and income, and therefore regional development in its multiple dimensions (environmental, social and economic) (Denardin *et al.*, 2022).

Along these lines, the research by Marrocos, Moraes and Gomes (2018) carried out a diagnosis of the characteristics and socio-environmental benefits of the certification standards of cocoa farms in the conservation of the Atlantic Forest in Bahia State. The results showed that organic certification was what most contributed to regional development.

METHODOLOGY

The research is applied, descriptive and quantitative, using non-probability sampling through a closed-end questionnaire. Sampling was non-probabilistic due to the wide dispersion of farmers in the Amazon region. In this sense, probabilistic sampling was not feasible.

Data collection for the study was facilitated by an extensive review of the literature, and the criteria for organic certification identified in the audit reports of the agri-business in which the certified farmers were the suppliers. Since 2009, the agro-industry has identified four priority sustainability themes in organic certification, namely: biodiversity conservation, product impact, supplier development for sustainability, and education. Agri-business commitments to these topics directly influence practices and the sustainable management of the supply chain.

The agro-industry has chosen to incorporate organic tropical fruits found in the Amazon's biodiversity into its portfolio in a way that is compatible with the conservation of forest areas, and with inclusion of community-based organizations and small farmers guided by the application of organic certification criteria in the relations between the agro-industry and its supplier communities. The agro-industry mainly shares knowledge with farmers and develops suppliers for sustainability, and therefore starts to form a direct relationship with the supplier communities. Organic practices favor

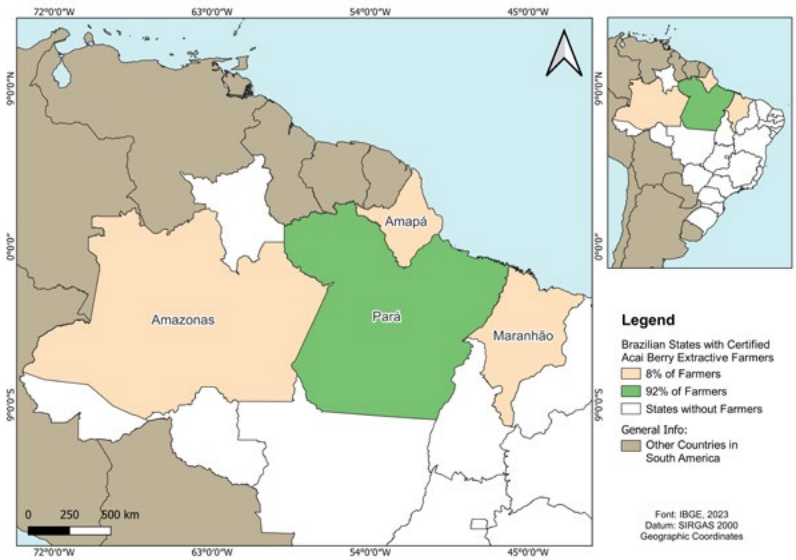
the conservation of biodiversity, water and soil, and also involve social aspects related to the sustainability of agricultural production. According to the 2018 agri-business audit report, the number of certified farmers had grown by 554% since 2009.

The agro-industry assesses all farmers that supply açaí berries with regard to aspects related to quality, the environment and social responsibility. This also includes human rights relative to risks such as: child labor, forced or slave-like labor conditions, and discrimination based on race, belief or gender. As a result, the implementation of social and environmental practices based on certification is a strategy the agro-industry has adopted in order to comply with the socio-environmental criteria required by customers and the government. Consequently, a premium price is paid for certified açaí berries.

THE RESEARCH INSTRUMENT AND THE SAMPLE

This study adopted a quantitative approach using a survey. The research involved the certified extractivist farmers of an açaí berry agro-industry in the Castanhal municipality of Pará State. According to the agro-industry registration database, there were 327 certified extractivist farmers in the population in July 2018, located in the states of Amapá, Amazonas, Maranhão and Pará: 92% corresponded to suppliers in Pará State and 8% in the other three states (Figure 1). We used a non-probabilistic sample of 206 farmers, which corresponded to 63% of the universe researched.

Figure 1 | Brazilian States with Certified Açaí Berry Extractivist Farmers



We chose the açaí berry agro-industry as a business that reflects the regulatory requirements of certified supply chains with regard to meeting customer demands and government regulations. Part of this certification process entails developing suppliers for sustainability, including technical training. The inclusion of smallholders, some belonging to community-based organizations, such as associations and cooperatives, increases the complexity of sustainable supply chain management.

We used 5 constructs to form our closed-end questionnaire: Environmental Practices (PRA), Social Practices (PRS), Customer Pressure for Socio-Environmental Aspects (PRC), Regulatory Compliance (CR) and Operational Performance (DOP), as shown in Table I.

Table I | Questionnaire

1. Dimension/Construct: Environmental Practices
PRA_01. I develop solely based on sustainability, utilizing natural resources responsibly to eliminate any potential environmental problem.
PRA_02. I regularly review how the work in the field is performed to eliminate potential environmental damage.
PRA_03. I have replaced most of the chemical inputs that may cause environmental problems with others that are not problematic (organic inputs), or I do not use these chemicals at all on my property.
PRA_04. I regularly modify how the work in the field is conducted to reduce the consumption of water, electricity and fuel, and the emission of polluting exhaust gases from boats.
PRA_05. I only use recycled or easily recyclable packaging for fruit storage and transportation.
PRA_06. I allocate much of the waste generated in the harvest to the production of organic fertilizer and handicrafts.
PRA_07. Waste water and other waste generated on the property are fully separated and undergo proper treatment for specific reuse, the aim being not to contaminate the environment.
PRA_08. I continuously collaborate with agribusiness buyers to deal with environmental issues.
2. Dimension/Construct: Social Practices
PRS_01. All the workers have access to and always use safety equipment to avoid work accidents in the stages of fruit collection, storage and transportation.
PRS_02. All the workers receive various types of training and are constantly encouraged to improve their activities in the areas of fruit collection, storage and transportation.
PRS_03. I always talk to all the workers to assess their level of satisfaction with the work.
PRS_04. All the workers, including those who are seasonal, are paid fairly.
PRS_05. All the fixed workers are employed following the labor legislation.

3. Dimension/Construct: Socio-Environmental Pressure from Customers
PRC_01. The customers **consider** the socio-environmental issues when they purchase our products.
PRC_02. The customers **greatly value** socio-environmental aspects (e.g. fair trade, biodiversity preservation).
PRC_03. The customers **prefer** to purchase from companies recognized for their socio-environmental work.
PRC_04. The customers **seek** information on suppliers' socio-environmental issues before buying products.
4. Dimension/Construct: Socio-Environmental Pressure from the Government
PRG_01. The government can further **press** socio-environmental issues, that is, increase inspection if agribusiness does not improve its socio-environmental action.
PRG_02. The government **require**s the açaí chain to comply with socio-environmental matters.
PRG_03. The government will certainly **increase** pressure regarding socio-environmental concerns over the next three years.
PRG_04. The government is **pressured** by groups (NGOs) to increase/improve socio-environmental measures.
5. Dimension/Construct: Operational Performance
OP_01. Organic compared to non-organic fruit presents higher **quality**.
OP_02. I guarantee **delivery** on time, that is, I have sufficient organic fruit available on my property to allow immediate dispatch.
OP_03. I can quickly **respond** to changes in delivery deadlines and/or demand volume.

The constructs were developed from previously tested scales: 1) environmental practices (Melnyk; Sroufe; Calantone, 2003); 2) social practices (Pullman; Maloni; Carter, 2009); 3) socio-environmental pressure from the customers (Ehrgott *et al*., 2011; Gualandris; Kalchschmidt, 2014; Mani; Gunasekaran, 2018); 4) regulatory compliance (Ehrgott *et al*., 2011; Sancha; Longoni; Gimenez, 2015; Mani; Gunasekaran, 2018); and 5) operational performance (Narasimhan; Swink; Kim, 2005; Schroeder; Shah; Peng, 2011; Wu; Ding; Chen, 2012).

The closed-end questionnaire consists of questions on a 5-point Likert scale, ranging from 1 ("strongly disagree") to 5 ("strongly agree"). For the pre-test, we initially presented the questionnaire to two researchers and four agricultural technicians from this agro-industry. Based on their reviews, some of the questions were rewritten to ensure they were clear to the respondents. A pre-test was

then carried out with 24 extractivist farmers to assess the comprehensibility and validity of the questions.

To evaluate the measurement model as to its validity and reliability, we suggested a descriptive statistic of the constructs and their respective items. The reliability of the constructs was found by calculating and evaluating the instrument's internal reliability (Cronbach's alpha), which sought to assess the internal consistency level of the indicators. As for the values used that had good reliability, the indexes had to be above 0.70, but values close to 0.60 were accepted due to being exploratory research (Hair *et al.*, 2009). The values in the results were above $\alpha = 0.60$.

We took extra care in the data collection phase, and this was necessary because riverbank extractivist farmers in the Amazon region suffered from territorial isolation, absence of Internet and even cellphone signal limitations, all of which hindered scheduling the research beforehand. These farmers sometimes lived on islands and access to them was only by river, and the journeys were often hampered by choppy water, making access even more difficult.

Data collection took place during September, October and November 2018. As far as ethical issues were concerned, at the beginning of the study, all the producers were informed of its purpose and duration. Participation was voluntary and anonymous. Ordinal numbers were assigned as a criterion for organizing the questionnaire. All the data were analyzed together with those of the other participants, and no individual information was disclosed among those surveyed.

Face-to-face data collection was also prioritized due to the characteristic lack of formal education of these farmers. In this research, 72.9% of the respondents had not even completed their elementary education. It is worth noting that in territories that have not yet been intensively developed, where there is a lack of roads that are adequately maintained, the local territories only offer the initial grades of elementary education.

The success of the research, therefore, was due precisely to the on-site visits, with the questionnaires being applied in the extractive farmers' social organizations. The average time taken to complete the questionnaire was 50 minutes per farmer. The purpose of the research was explained at the time, and we ensured that the respondents fully understood the questions.

STATISTICAL ANALYSIS

Note that when we applied the pre-test, we saw that the respondents sometimes found it difficult to understand the variables that defined the research constructs. Therefore, we adjusted the language to fit the context researched, but without changing the essence of the scales.

After the collection phase, we analyzed the data using multivariate statistical techniques, aided by the software, SPSS 20.0 (Statistical Package for Social Sciences). We identified sustainable practice standards for the production of the açaí berry, and obtained the pressures and operational performance by exploratory factor analysis (EFA), which analyzed the relationships between the correlated variables, and simplified them by defining common latent factors (Hair *et al*., 2009).

We carried out factor analysis using the Principal Components method with Varimax Rotation (see Table II). To establish the adequacy of the factor analysis data, we undertook two tests: the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO Test) and Bartlett's Test of Sphericity (BTS Test). The KMO test gave a statistic of 0.815 for practices and pressures, and a value of 0.648 for operational performance, confirming that the variables were correlated, which, according to Hair *et al.* (2009), indicated that the sample was suitable for factor analysis. As for Bartlett's sphericity test, the level of statistical significance obtained was 0.000 (p-value < 0.001) in both analyses, leading to rejection of the null hypothesis of the correlation matrix being identical, that is, it confirmed the existence of a correlation among the variables, which justified the use of this technique.

Table II. Exploratory factor analysis

Variable	Components				Commonalities
	F1	F2	F3	F4	
PRC_4	**.839**	.019	.145	.149	.748
PRC_2	**.827**	.232	-.108	.034	.751
CR_3	**.673**	-.063	.056	.528	.740
PRC_3	**.556**	.485	-.149	.304	.659
PRS_1	.087	**.799**	.115	.289	.743
PRS_2	.030	**.735**	-.263	.329	.719
PRC_1	.246	**.642**	.462	.012	.686
PRA_2	-.429	**.573**	.451	-.054	.719
PRS_5	.419	**.496**	-.067	-.002	.426
PRA_5	-.013	-.148	**.807**	.053	.676
PRA_4	.140	.077	**.747**	.032	.585
PRA_3	.593	.174	**.612**	.019	.758
PRA_7	-.320	.132	**.599**	.274	.553
CR_1	.058	.107	.126	**.762**	.611
CR_4	.233	.371	.143	**.673**	.666
CR_2	.191	.396	-.485	**.509**	.688
SQLoads	4.744	2.769	2.098	1.114	10.725
Trace (%)	29.652	17.305	13.112	6.962	67.032
Sample adequacy:		KMO = 0.815		TB = *p-value*< 0.001	

[a.] **Converged rotation: 7 iterations**

When we had obtained the scores of the factors, we used multiple linear regression. The estimated model was:

$$D_i = \beta_0 + \beta_1 F_1 + \beta_2 F_2 + \beta_3 F_3 + \beta_4 F_4 + \epsilon \quad (1)$$

where:

D_i= Operational performance

F1= Sustainable natural resources

F2= Sustainable human resources

F3= Sustainable awareness

F4= Sustainable regulations

ϵ = Random error

We used the Weighted Least Squares (WLS) estimation method as a way of eliminating the problem of residual heteroscedasticity caused by the use of a cross-section data sample, while the variable used as a weighting factor was the size of the farmer's property.

After generating the regression residuals, we tested the joint significance of the regression coefficients we had obtained with the following hypothesis structure:

H0: $\beta 0=\beta 1=\beta 2=0$

H1: there is at least one $\beta 1\neq 0$

We assessed residual normality using the Kolmogorov-Smirnov and Shapiro Wilk tests. The assumption of autocorrelation among residuals was evaluated using the Durbin-Watson test, while we tested for the presence of heteroscedasticity using the White test. All evaluations took into account a statistical significance of 5%.

The control for the variables was the size of the farmers' properties. We were controlled by the property size, since farmers with large areas could have had access to bigger and better resources for developing socio-environmental practices than small farmers, but the latter could have been held more accountable by the government and customers (Danese; Lion; Vinelli, 2019). Smallholders, on the other hand, could be more flexible and better able to implement socio-environmental practices more quickly (Malik *et al.*, 2019).

RESULTS

PROFILE OF THE RESPONDENTS

The majority of the certified extractivist farmers had only been educated to the elementary education level, and some had not even completed it (91.1%). Most farmers (58.7%) had had a supply partnership with the agro-industry between one and four years. The workforce was characterized as being family units (82.6%). The properties covered an average of 23 hectares, with a mean production of 89 tons per harvest. In the 2018 harvest, the average price paid for the certified açaí berry in the international market was US$ 295 per ton.

Those who were in the initial link of the açaí berry chain were most frequently extractivist farmers and members of a cooperative; they represented 95% of all those we surveyed. As for the level of certification, 57.60% were in the process of implementing organic practices, and 42.40% had already implemented them.

EXPLORATORY FACTOR ANALYSIS

All the sustainability dimensions were generated from factor analysis of the practices. Most variables had a strong relationship with the retained factors, with a satisfactory level of commonalities (above 0.5), except the PRS_5 variable, which had a value of 0.426 (see Table II). However, we left this variable in the model as it was related to factors that were intrinsic to the social sphere in the supply chain, like child labor and slave labor. So, we extracted four factors that resulted from the interactions of 16 variables, which together explained 67.032% of the variance (Table II).

Factor 1 (F1), the **sustainable natural resources (SNR)** dimension explained 29.652% of the total variance. To comply with environmental regulations and meet customer criteria, farmers eliminated any potential environmental problem caused by an aspect of production, and sustainably managed the areas by, for example, preserving the native forest, preparing the soil without burning, and preserving the biodiversity. They also used organic inputs instead of chemical inputs that could cause environmental problems. Farmers understood that customers looking for certified products value were able to choose environmentally correct products and services, which resulted in greater regulation along the chain, and made these practices essential in the organic certification process. Factor 1 also added to the perception farmers had that the government would increase pressure regarding environmental issues. In this sense, as Ehrgott *et al.* (2011) emphasized, greater access to customer information and increased legal requirements make companies' socio-environmental practices more transparent.

Factor 2 (F2), the **sustainable human resources (SHR)** dimension explained 17.305% of the total variance. This factor showed the qualification the agro-industry provided to the extractivist farmers, thus contributing to the human capital, such as training in management and organic production, good agricultural practices, and how to run a family farm. Human rights issues (no child labor, legalization of the workforce, and compliance with work safety rules) were also addressed. These practices were also regularly monitored.

The farmers understood that customers who buy certified products consider these social aspects, and that this has an impact on their purchasing decisions. Customers also influence companies to negotiate more effectively with their suppliers to stress the adoption of social

sustainability. This can significantly contribute to price premiums for having a favorable reputation, and because of the brand's identification with sustainability (Huang *et al.*, 2016).

Factor 3 (F3), the **sustainable awareness (SA)** dimension, explained 13.112% of the total variance because some environmental practices had already been incorporated into the production process by the açaí berry extractive farmers, for example, recycling biodegradable packaging used in storing and transporting the fruit; reduction in electricity consumption; cutting polluting gas emissions from boat engines; total sorting, treatment and disposal of sewage and garbage generated on the properties. Note that the farmers in this chain were riverside "extractivists" whose way of life and work are traditionally based on managing the natural resources of agro-forestry products, where the distinction between cultivation and extractivism "is fluid and difficult to define once and for all" (Pepper; Alves, 2015, p. 3). Many of the environmental practices required by certification, therefore, were already part of the *modus operandi* of these farmers, and so had already been incorporated into their routines before the process.

Experience and knowledge of the location were relevant factors in the relationship of riverside farmers with the environment and their use of natural resources, and this had an impact on the environmental dimension, according to a report by the Brazilian Agricultural Research Corporation (EMBRAPA, 2013) and Souza *et al.* (2017).

Factor 4 (F4) explained 6.962% of the total variance and was related to the **sustainable regulation** (SR) dimension. This factor demonstrated that the government was driven by pressure exerted by NGOs and customers to increase inspection in organizations (companies), for example, with the intention of forcing them to improve the socio-environmental actions within the chain, which were mainly upstream where the farmers were located.

RESULTS OF THE MULTIPLE REGRESSION

The independent variables were represented by the four dimensions we identified in the factor analysis: sustainable natural resources (SNR), sustainable human resources (SHR), sustainable awareness (SA), and sustainable regulations (SR). The dependent variable was operational performance, which was in line with Famiyeh *et al.* (2018).

The adjusted model showed that 60.7% of the variations in the performance constructs resulted from the variation obtained by the dimensions SNR, SHR, SA, and SR. The result of the F test showed that the basic hypothesis, that the estimated parameters had a null value, was rejected. The result of the VIF test showed the absence of multicollinearity because the VIF value was less than 10, which we had expected since the constructs were obtained based on the principal components that generated uncorrelated factors. The Kolmogorov-Smirnov test applied to the regression residuals showed that they were normally distributed. The estimated parameters were all significant (p-value .000 and .001) and showed that each of the factors had a positive relationship with performance. The sustainable human resources (SHR) dimension was the one with the greatest weight of all those that explained the variations in performance since it gave the highest Beta value.

DISCUSSION

The certified organic açaí berry supply chain made it possible to analyze how the dyad, agro-industry and extractivist farmers was driving sustainability dimensions based on socio-environmental practices defined by government and customer criteria. The socio-environmental practices of organic certification we examined in this research were implemented by the relationships between the dyad, and, according to Kirchoff and Falasca (2022), may be reflected in the chain performing better. The findings of this research also enabled us to state that context has an influence on the sustainability dimensions and that they result from practices guided by the criteria of the customers and government, corroborating Oftedal *et al.* (2021), who emphasized that the organizational context influences the emergence of sustainable practices. The results showed that organic certification can be a driver of the sustainability dimensions, despite the configuration of their different assigned weights and supply chain context of certified açaí berries from the Amazon.

The company can use certification to ensure that small farmers follow environmental and social legislation. The technical guidance provided by the agro-industry favors sustainable management of natural resources, thus influencing the SNR dimension. More practices are implemented that make up the social dimension of small farmers, such as job and income stability, job security and adequate

working conditions (Santos; Guarnieri; Filippi, 2023), which can deter the use of child labor, non-compliance with labor laws, etc., thus favoring the SHR dimension. In this sense, it corroborates the study by Croom *et al.* (2018) by demonstrating that companies with the highest levels of social sustainability orientation achieve superior operational performance.

Premium price and other benefits resulting from adhering to environmental and social practices can also improve the farmer's operational performance (Schoneveld *et al.*, 2019). When the SNR and SHR dimensions are worked on in a supply chain, the CS dimension is internalized. For example, the work of Ibanez and Blackman (2016) emphasized that the environmental awareness of farmers may be the initial reason for their adherence to certification practices. This finding is also consistent with the study by Valenciano-Salazar, André and Castro (2021), which reported that ethical aspects are similar in importance to economic and strategic aspects when adopting organic certification such as fair trade. The result of the operational performance of this work is directly related to the sustainability dimensions developed by the implementation of socio-environmental certification practices.

Organic certification reinforces government requirements. Small farmers need to comply with environmental and labor legislation, and land and environmental regularization provides them with access to the environmental declarations they need for the purpose of extracting açaí berries. However, the government is not always able to fulfil its role of inspecting all properties, especially in a context such as the Brazilian Amazon considering the territorial distances; in this sense, as Goedhuysa and Sleuwaegen (2016) highlighted, certification standards can reduce the institutional distance between farmers and government. Certification helps companies and suppliers to become efficient in socio-environmental practices, which improves the RS dimension. This means that organic certification acts as an external agent, guaranteeing minimum sustainable standards, and helps RS become a reality in the daily life of farmers.

While governments have many connections with certification standards, normally they are unable to sustain them alone, because they are incapable of addressing many aspects of the sustainability of agricultural production and its markets (Wijaya; Glasbergen, 2016). To create new

management practices, however, private certification not only interferes with the market, but also changes relationships among the actors involved, the companies and governments, at the same time that governments improve the functioning of private arrangements. Therefore, strengthening this relationship makes institutions more efficient, and is fundamental for improved operational performance (Goedhuysa; Sleuwaegen, 2016).

ACADEMIC, PRACTICAL AND REGIONAL DEVELOPMENT CONTRIBUTIONS

This study contributes to the sustainable management of supply chains, especially those implementing organic certification practices. It does so by demonstrating the weight of these practices that prevail in the driving of sustainability dimensions based on customer and government criteria. From an academic point of view, these practices are seen as imitable resources that are transferable between the dyad studied (açaí berry agro-industry and extractivist farmers), which can contribute to better operational performance (Carter; Kosmol; Kaufmann, 2017). At the same time, the theoretical model we adopted allowed us to understand that, in the context of sustainable supply chain management, imitable practices support performance results rather than establishing a sustainable competitive advantage (Kirchoff; Falasca, 2022).

We can infer the value of relational practices (Carter; Kosmol; Kaufmann, 2017), especially in sustainable supply chain management (Silva; Pereira; Gold, 2018), thus helping extend the field of study. We were also careful to develop our analyses by examining organic certification relationships, considering that Jarzabkowski *et al.* (2015) had emphasized the risks of studying isolated practices, and the need to generate more precise theories about the impacts of the practices and critical factors that explain different results.

Certifications are important mechanisms for using practices (Tuczek; Castka; Wakolbinger, 2018). Practices implemented and monitored aim to meet the criteria required in a certification process. As a result, there is an increased awareness of environmental and social responsibility, as well as of their impact on operational performance. Note that this work also contributes theoretically by presenting the driving of sustainability dimensions based on organic certification.

One of the interesting findings of this research was the strong, positive, significant relationship that exists between the SHR dimension and operational performance. This result contributes to the body of literature, and advances discussion on the human dimension of sustainability in the implementation of socio-environmental practices. Jabbour and Renwick (2018) highlighted the importance of combining studies that involve human dimensions, such as recruitment, training, assessment, and reward practices, along with the environmental mission and objectives of organizations for sustainability. In turn, investment in human capital has a positive impact on quality results, especially among small farmers, as shown by Roldan *et al.* (2023). Investment in human capital is still an incipient topic in the sustainability literature (Roldan *et al.,* 2023).

In organic certification chains of Amazonian extractive products, as in the case of the açaí berry, the environmental practices of farmers had already been part of their daily lives and their relationship with the riverside ecosystem before certification, and this has had an impact on the sustainability dimensions. So the sustainable awareness dimension already exists among extractivist farmers, which, according to Lima, Neutzling and Gomes (2021), results in an ecologically regenerative perspective that facilitates organic certification, since different forms of knowledge are considered, which allows farmers to have access to certification without being subjected to difficult, costly, bureaucratic procedures that could restrict farmers' confidence about the organic production standards (Lima; Neutzling; Gomes, 2021).

As for the study's practical contribution, aspects related to sustainability have been gaining importance in recent years. There is now a greater tendency for the market to demand food products that have strict quality and safety standards (Tuczek; Castka; Wakolbinger, 2018). Society in general is also demanding that socio-environmental requirements be met by companies (Edinger-Schons *et al.*, 2018). Therefore, our study provides practical guidance on the need to enhance design relationships between agro-industry and farmers so as to build and disseminate the sustainable certification practices that must emerge to boost the operational performance in an organic certification supply chain, more specifically in the context of the Brazilian Amazon.

Certifications are also a means of increasing collaborative relationships within the dyad, and ensuring that smallholders have access to information and best practices. It is a win-win relationship, where the company gains by being qualified to serve a more demanding market, and the farmers benefit by being paid premium prices for their products. Knowledge sharing between the agro-industry and extractivist farmers, and efforts to develop suppliers for socio-environmental sustainability is important for organic certification. This increases trust and commitment, these constituting a motivational and attractive factor that intensifies the collaborative power of the relationship (Yuen *et al.*, 2018).

The results of this research have interesting implications for the field of management and regional development. Certification contributes to fairer trade for producers, considering territories where there are socio-economic weaknesses for small producers, as is the case in the Amazon. The compliance standards required by organic certification guarantee improvement of the socio-environmental sustainability dimensions through collaboration and training of extractive producers, based on the valorization of the territory's resources for the entry of producers into the market (Marrocos; Moraes; Gomes, 2018). In addition, our results highlight the need for the government to promote policies and incentives that facilitate organic certification practices by farmers, the aim being to contribute to regional development in the Amazon. We emphasize that public policies play a fundamental role in the long-term maintenance of small producers' certifications and sustainable practices. This statement can be corroborated by Denardin *et al.* (2022), which pointed out that, when thinking about the vulnerabilities of rural populations, the State needs to resume its role in the strategic induction of public policies that correct or minimize social inequalities, environmental and labor crises, promote regional development based on new sustainability and socio-environmental ethics, thus aiming, among other things, at sectoral policies that will strengthen activities and income in family farming.

CONCLUSIONS

The study of the implementation of sustainable practices in an extractivist supply chain, such as that of the açaí berry, to which there was restricted access both in terms of its geographic location and data collection, enables us to understand how these small farmers perceive sustainability and its benefits. The study revealed that, through organic certification, practices considered imitable and transferable can contribute toward improving operational performance. The results of this research, therefore, help advance the topic of sustainability by expanding the ongoing discussion about sustainable management in supply chains.

The research also identified four dimensions that emerge from organic certification and represent aspects related to sustainability, namely: **sustainable natural resources**; **sustainable human resources**; **sustainable awareness**; and, finally, **sustainable regulation**. All the sustainability dimensions were generated from factor analysis of practices, and had a positive, significant relationship with operational performance, the greatest impact being on SHR.

Note that this research also has its limitations. First, this study is quantitative and cross-sectional. Future research could analyze the implementation of sustainable practices over time, or seek to understand how smallholders understand sustainability based on a case study to consider the contexts researched in greater detail. Second, since the sample comprises small farmers who have organic certification for an extractivist product found in the Amazon and already have a sustainable relationship with the forest, other studies could compare certified and uncertified farmers, or even just the certified operating in different contexts. Future agendas could explain in depth the motivational factors that integrate farmers into the socio-environmental practices of certified products, and include the difficulties and challenges that support the transition to sustainable certification practices, as perceived by the customer and the government.

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