

IMPORTANCE OF PINHÃO IN THE CONSERVATION OF ARAUCARIA FORESTS AND THE SOCIAL ROLE OF THE CONSUMER MARKET

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Resumo

Importância do pinhão na conservação das florestas de araucárias e o papel social do mercado consumidor. As florestas de araucárias, são atualmente ameaçadas de extinção, devido à exploração e venda desordenada de sua madeira no início do século XX. Em regiões em que essas florestas estão disponíveis, os agricultores vendem as sementes de araucária, o pinhão, como forma de agregar renda. Os produtos florestais não-madeireiros (PFNM) são uma fonte de subsistência para as comunidades tradicionais da floresta e agricultores locais, bem como uma alternativa para o desenvolvimento territorial. Para garantir a manutenção efetiva do germoplasma florestal de forma sustentável, é necessária a participação coletiva dessas comunidades, agricultores, governo e sociedade. Este estudo analisa o consumo de pinhão e como esse consumo pode afetar a conservação das florestas de araucárias. Foi realizada a técnica de associação livre de palavras e pesquisa exploratória contendo um questionário com 18 questões. A análise fatorial exploratória mostrou que quatro fatores foram suficientes para mensurar as principais características que devem ser consideradas para auxiliar no desenvolvimento de uma cadeia produtiva que beneficie as comunidades dependentes desses recursos, incentivando a proteção das florestas. Concluiu-se que a conservação da araucária está ligada à percepção dos consumidores e que a valorização do pinhão só é possível através da integração de agricultores adeptos da agricultura sustentável, e a sociedade.

Palavras-chave: consumidor, pinhão, produto florestal não madeireiro, sustentabilidade

Abstract

Araucaria forests are currently threatened with extinction, due to the disorderly exploitation and disorderly sale of their wood in the early 20th. In regions where these forests are available, farmers sell araucaria seeds, the pinhão nut, as a way of adding income. Non-timber forest products (NTFP) are a source of livelihood for traditional forest communities and local farmers, as well as an alternative for territorial development. To ensure the effective maintenance of forest germplasm sustainably, the collective participation of these communities, farmers, government, and society is necessary. This study analyzes the consumption of pine nuts and how this consumption can affect the conservation of araucaria forests. Free word association technique and exploratory research were performed and a questionnaire containing 18 questions. The exploratory factorial analysis showed that four factors were sufficient to measure the main characteristics that should be considered to help in the development of a production chain that benefits communities dependent on these resources, thereby encouraging the protection of forests. It was concluded that the conservation of the araucaria is linked to the perception of the consumers and that the valorization of the pinhão is only possible through the integration of farmers who are adept at sustainable agriculture, and society.

Keywords: consumer, pinhão seed, non-timber forest product, sustainability.

INTRODUCTION

Araucaria angustifolia (Bertol.) Kuntze (Araucariaceae) (araucaria or Brazilian pine), occurs predominantly in cold and humid mountainous regions in southern and southeastern Brazil, and northeastern Argentina. Its area of occurrence is estimated at 185,000 km², but currently covers only 0.8 – 2% of this territory and is therefore categorized as critically endangered at the global level (BRASIL 2014). This condition is the result of indiscriminate wood extraction in Brazil during the 19th and 20th centuries (KOCK; CORREA, 2010).

Araucaria seeds, popularly known as pinhão nuts, or pinhão, are products of a fertilization process and egg development. These processes form seeds grouped in structures called female strobiles or gynostrobiles, known as pine cones (WENDLING; ZANETTE, 2017). Not only is pinhão nut widely consumed in southern

Brazil, it also represents cultural values related to habits, memories, and feelings for residents of regions where the species occur (GODOY, 2013).

The commercialization of pinhão nut can serve as a tool for the conservation and restoration of araucaria forests. However, policies that aim to standardize the planting of trees and the commercialization of seeds, as well as research on the management and genetic improvement of the species are vital.

The problem lies in the seasonality, perishability, and lack of industrialization of the pinhão nut, in addition to the scarcity of nutritional information and the versatility of this nut as food (MARQUES *et al.*, 2021). The elaboration of norms or agreements with participants from different segments of the society can enable the adoption of a minimum protocol of guidelines that promote the sustainable management of the activity by respecting the environment, culture, and dynamics of the populations involved.

The pinhão nut is a food that aggregates these healthy food characteristics that allow food producers to tap into these unexplored opportunities, maintain, and even increase their market share, and introduce innovations in their products.

This research is not restricted to Araucaria forests, as it can contribute to the advancement of studies that enable the commercialization of non-timber forest products (NTFP) from other ecosystems. According to several studies (SHARMA; KALA 2016; TAGLIARI *et al.*, 2021), non-timber forest products (NTFPs) play important roles in the livelihood of millions of rural and urban people worldwide.

Understanding the profile of individuals in relation to environmental conservation is complex, especially while assessing their acceptance and perception of foods in this environment. It is necessary to consider psychological and social aspects along with economic aspects.

According to Siqueira (2008), people experience environmental issues differently, based on their individual perceptions and peculiarities. Therefore, environmental education tools do not always depict behavioral changes. Changes that are vital in fighting pandemics can prevent other threats to public health and environmental degradation.

The sustainability rhetoric promoted by governments, non-governmental organizations, and companies proves to be ineffective, as they are built without popular participation. Furthermore, the information on environmental preservation and protection is absorbed into the collective and individual consciousness but does not necessarily reflect their way of life. This behavioral change is only possible if there are perceptible connections between the individual's environmental problems and the impacts generated in their daily habits, especially in production and consumption patterns (LIOBIKIENĖ; POŠKUS, 2019).

Qualitative techniques are widely used in the fields of sociology and psychology to identify individuals' habits and behaviors. Word association is a simple exploratory qualitative method in which the researcher encourages the respondent to discover hidden motivations based on associations, and the use of questionnaires is also an example of an assessment instrument that facilitates the inference of the opinions of a specific group in relation to a product or service of interest (YOUNG, 2015).

Thus, our study aimed to analyze the perception of consumers of pinhão nut from Araucaria forests, how it affects their conservation values in these environments, and verify opportunities for sustainable development and the recovery of endangered forests through behavioral changes, integrating society, public policies, and conservation.

MATERIALS AND METHODS

The study was carried out in Brazil and was approved by the Ethics Committee of the Federal University of Pelotas under the number CAAE 76628617.0.0001.5317. Participants were recruited via social networks to reach all regions of the country. A total of 1100 Brazilian consumers participated.

Free Word Association

The free word association test was conducted through the Google docs web interface, in which participants were asked to spontaneously write the first four words, phrases, or terms that came to mind while viewing a photo of pinhão nuts (Figure 1). For data analysis, followed by the calculation of the frequency of the mention of each word. Only valid words that correlated with the object of the study were considered, Words cited by at least 5% of consumers were grouped into categories according to the most relevant words associated with the pictures, or those that were recurrent or similar. Words were grouped into categories using coding by triangulation, data and word classification were performed by at least four researchers with experience in the word association method, as recommended by (GUERRERO *et al.*, 2010). Principal component analysis was carried out in the covariance matrix, to obtain a map of the research participants' perceptions.

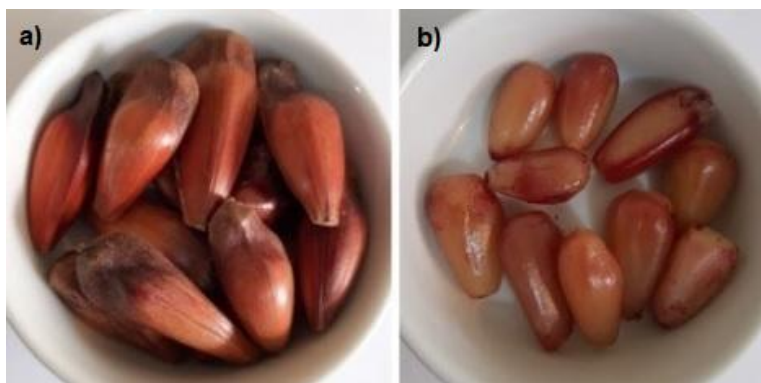


Figure 1. a) Pinhão raw b) Pinhão shelled and cooked.
Figura 1. a) Pinhão cru b) Pinhão descascado e cozido.

Attitudinal questionnaire

In addition to word association, participants were invited to answer a closed questionnaire containing questions related to forest preservation and the consumption and trade of pinhão nuts, as well as sociodemographic questions about gender, age, education, and region of the country in which they reside.

As an instrument for data collection, a structured questionnaire with 18 questions was used, with “yes”, “no” and “maybe” as answer options. Except for question 4, the participants could answer freely. The research used was qualitative, seeking to approach a specific topic characterized as convenience research. The questionnaire used is shown in Table 1.

Table 1. Variables that made up the questionnaire.
Tabela 1. Variáveis que compuseram o questionário.

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- Q1) Have you ever consumed, or were you aware of the edible seeds called “pinhão nuts?”
Q2) What time of year do you consume pinhão nuts?
Q3) Do you know other ways to consume pinhão nuts besides in cooked form?
Q4) Name a food that you know is prepared with pinhão nuts or that you deduce can be prepared.
Q5) Do you believe that pinhão nuts can be considered beneficial to health?
Q6) Do you consider the pinhão nuts to be an expensive product?
Q7) Do you find it easy to acquire pinhão nuts commercially?
Q8) What attributes do you consider important while purchasing pinhão nuts?
Q9) Would you consume more pinhão nuts if they were more readily available year-round?
Q10) Do you know which forest or tree pinhão nuts are obtained from?
Q11) Do you know how pinhão nuts is collected?
Q12) Did you know that Araucaria forests are in the process of going extinct?
Q13) Do you recognize that people, in the role of consumers, can help preserve forest species?
Q14) Do you believe that only the government is responsible for actions to preserve forests?
Q15) Do you know what non-timber forest products are?
Q16) Do you know which forests are extinct in Brazil and the world?
Q17) Do you believe that information about forest preservation (propagated through school, media, newspapers, radio, advertising) is sufficient?
Q18) Do you believe that people are encouraged (school, media, newspapers, radio, propaganda, government) to preserve forests?
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The questionnaire was analyzed using exploratory factor analysis (EFA) to verify the variables observed in the total dataset.

The Kaizer method was used for the retention of eigenvalues, and the Varimax rotation was selected. The Kaizer-Meyer-Olkin (KMO) test was performed, and the Bartlett test sphericity (BTS) was also applied with a significance of $p < 0.05$. Cronbach's alpha coefficient was determined to analyze of the factorial model. The software used for the analyses was Jasp version 14.1.

RESULTS

As for the characteristics of the participants, it was observed that 72.4% of the sample was composed of females, 27.2% males, and 0.4% other genders. Most patients (37.2 %) were aged between 25 and 35 years.

Regarding the respondents' education, 45.9% had completed high school, and 36.4% lived in the southern region of the country.

The 4400 words cited, alone or in sentences, were grouped. Most responses were associated with the other terms cited. Ten dimensions were classified into categories related to the words with the greatest impact mentioned during the association. Table 2 shows the frequency of mention of the dimensions, categories, and examples of words that were mentioned.

Table 2. Frequency of mention of the dimensions, categories, and examples of individual associations when participants think of pinhão.

Tabela 2. Frequência de menção às dimensões, categorias e exemplos de associações individuais quando os participantes pensam em pinhão.

Dimension	Categories	Percentage of mention (%)
Consumption	Cooking process (boiled, roasted, salted) Occasion (family, childhood, confraternization, party) Culinary (parrilla, candy, toasted flour mixed, flan, appetizer)	37.53
Hedonic attitudes and feelings	Positive hedonic (tasty, good, yummy) Negative hedonic (dislike, bad, hard to peel) Positive feeling (love, pleasure, nostalgia, memories, comfort food, happiness) Negative feeling (difficult)	33.07
Weather/season	Winter, cold, seasonal	29.60
Food association/other foods	Mulled wine, cheese, fish	23.72
Sensory characteristics	Texture (hard, juicy, soft, tender) Appearance (white) Flavor (savourless)	20.41
Cultural/regional aspects	Culture (family, tradition, culture, Junine party) Regional (typical dishes, south region, Paraná State, Pampa, mountain range)	19.15
Non-sensory characteristics	Price (expensive price, high price, cheap price) Purchase (hard to find, devalued)	15.07
Specie/Environment	Specie (araucária, pine cone, pinus, seed, gralha-azul (* <i>Cyanocorax caeruleus</i>), Environment (extinction, preservation, forest, threatened, native, natural)	15.24
Health/nutrition	Nutritional characteristics (carbohydrate, vitamin, caloric, starch) Health (nutritious, health, healthy)	6.65
Different/Unknown	Different (unique, different) Unknown (exotic, unknown)	5.55

The dimension related to 'consumption' was the most mentioned by the 37,73% participants, followed by Hedonic attitudes. "Cultural/regional aspects" were cited by over 19% of respondents. Through the word association test, it was also found that 5.5% of the terms cited referred to the lack of knowledge of consumers in the rest of the country in relation to pinhão nut.

The principal component analysis performed on the covariance matrix of the mean scores of the dimensions evaluated by the participants in the word association analysis is shown in Figure 2. The two components explained 76.09% of the variation, with F1 being responsible for 53.47% of the variation, F2 by 22.62%. From this graph, it is possible to observe the relationship between the dimensions categorized in the word association test.

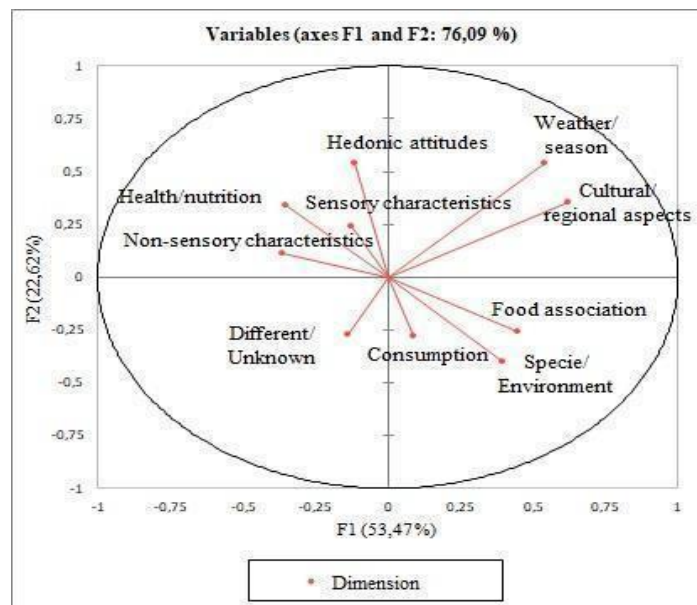


Figure 2. Principal components analysis performed on the covariance matrix of the dimensions scores of pinhão consumers.

Figura 2. Análise de componentes principais realizada na matriz de covariância dos escores das dimensões de consumidores de pinhão.

Questions about consumers or potential consumers of pinhão nut and their perceptions about forest preservation and the participation of society and government in environmental issues were analyzed by factor analysis, and the values verified are presented in Table 3.

Table 3. Description of factors retained by the Kaiser method from the scores obtained in the questionnaire (eigenvalue >1).

Tabela 3. Descrição dos fatores retidos pelo método de Kaiser a partir dos escores obtidos no questionário (autovalor >1).

Factor	Eigenvalue	% of Variance
1	4.93	31.18
2	3.24	20.35
3	1.96	13.60
4	1.91	12.85
Total variance (%)		77.98
KMO		0.88
Cronbach alpha		0.87

Seventeen factors were extracted (question 4 – Table 1, was not added to the data) using the Kaiser factor retention criterion, and four were retained (those with eigenvalues greater than 1). The four retained factors explained 77.98% of the total common variance of the variables observed in the questionnaire (Table 1). The measure of the adequacy of the questionnaire by Kaiser-Meyer-Olkin (KMO) was satisfactory (0.88). The Cronbach's alpha variable indicated that the variables were valid and reliable (0.87) for further analyses. The minimum acceptable value for alpha is 0.70, where values between $0.75 < \alpha \leq 0.90$ are considered to have high data reliability.

The path graph (Figure 3) demonstrates the issues related to factors from the exploratory factor analysis. The red and blue lines correspond to negative and positive correlations respectively. The more saturated and thicker the lines, the greater the correlation.

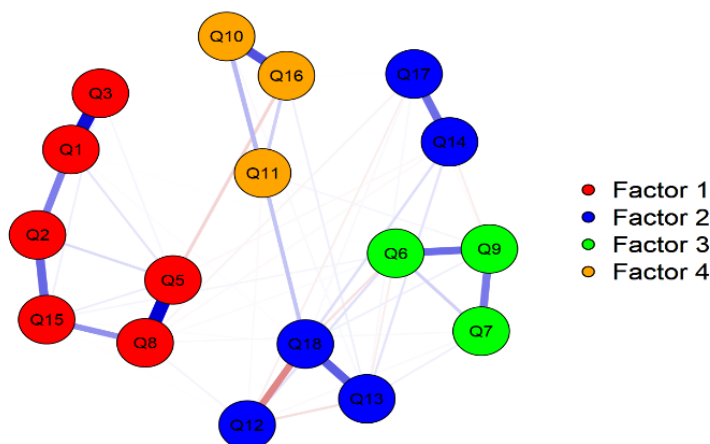


Figure 3. Network graphic of the correlation matrix between the questions and their factors.

Figura 3. Gráfico de rede da matriz de correlação entre as questões e seus fatores.

The first domain (F1) comprised six of the 17 items in the questionnaire. Factor 2, with five grouped questions. Factor 3 is linked to the issues pertaining to the commercialization of pinhão nuts, its relationship with prices (Q6), access (Q7), and seasonality (Q9). Three questions that are associated with Factor 4 (Q10, Q11, and Q16).

DISCUSSION

Free Word Association

The dimension related to 'consumption' was the most mentioned by the participants. In this category, words that refer to the method of preparation, regional dishes, gourmet, and occasions where pinhão nuts are usually consumed are included. Pinhão nuts are an essential ingredient in traditional southern dishes, such as *entrevero*, pine nut soup, and *farofa*, but the most authentic way to consume pinhão nuts is “*sapecadas*,” a technique in which the seeds are thrown into a fire made with pine leaves (*grimpas*) that are removed before serving the seeds (GODOY, 2013).

Like Brazil nuts (*Bertholletia excelsa*) that generate more than 25 million US dollars a year in exports, pinhão nut can also be part of “*haute cuisine*” without being limited to local cuisine. According to (SCHWARK *et al.*, 2020), an increasing number of consumers want to know where their food comes from and how it is produced, and *haute cuisine* follows the trend of offering exotic ingredients as a form of innovation.

Hedonic attitudes and feelings were the second-most cited dimension. As mentioned, it is observed that pinhão nut is mainly identified with positive and nostalgic feelings, while being cited as a “*comfort food*.” Positive feelings and the consumption of pinhão nuts appear to be associated with childhood or homemade food as well as to nostalgic memories of family or celebratory meals, placing it in the niche of comfort food. These foods are usually prepared simply or traditionally (SPENCE, 2017).

The group of words cited in the “*Weather/season*” dimension reflects one of the main problems regarding the commercialization of pinhão nut. The seasonality of its production, associated with a high degree of perishability, restricts the sale of the product to a short annual period, namely autumn and winter. Additionally, the low level of industrialization, sold basically *in natura*, ends up concentrating sales only in the months of production. Adding value by obtaining flour, for example, can make pinhão nut more useful for the production of various food products, and increase the volume of resources allocated to its collection (PERALTA *et al.*, 2016).

Araucaria represents a high cultural value for rural family communities, however, this valorization must be expanded, not only on a territorial level but also on national and international levels. The sale of pinhão nuts can serve as a tool for the conservation and restoration of *araucaria* forests, as long as the rural community values the species as a cultural symbol and sustainable resource that generates income (TAGLIARI *et al.*, 2021).

The “*non-sensory characteristics*” involved quotes for buying and selling the pinhão nut. The high price is justified by it being a seasonal product and extractivism. The price of agricultural products is characterized by their variability over time. In other words, it is difficult to predict and control demand and supply.

In 2008, the Federal Government of Brazil created a policy, the minimum price guarantee policy for sociobiodiversity products (PGPM-Bio), to guarantee minimum prices for extractive producers. This policy aims to pay the producer a subsidy amount to settle the difference between costs and the value for which the product should be sold. This prevents losses incurred by the producer and facilitates sustainable production (CONAB, 2021) however, it was only from 2013 that pinhão nuts were included in that public policy (VIEIRA-DA-SILVA;

MIGUEL, 2017). Furthermore, access to the policy requires the presentation of several documents issued by accredited bodies, making access difficult for producers who live in more isolated areas. Filling out records and carrying out operational procedures also requires knowledge of terminology and good quality internet connection (GUENEAU; DINIZ, 2020).

Quotations referring to “Specie/Environment” included words related to araucarias, animals that make up these forests, and aspects of environmental preservation. The devastation of mixed rainforests started at the beginning of the 20th century, first with the commercialization of wood, and later, the transformation of the forests into crops. One cannot neglect the fact that araucaria seeds are an important food resource for several species during the winter. Plant species with large seeds dispersed by local fauna are the most sensitive and threatened in the Anthropocene, and require controlled management so that the associated fauna is not harmed (EMER *et al.*, 2019).

The dimension “Health/Nutrition” indicates that some consumers know the nutritional benefits of consuming pinhão nut. Godoy (2013) interviewed pinhão nuts consumers and concluded that they were unaware of most of the nutrients in the seeds. However, they recognized it as a natural and beneficial food that can be consumed by the whole family (MACEDO *et al.*, 2020).

Pinhão nut is considered a typical food in the southern region of Brazil, with its largest sales volume occurring in June and July. The production chain at the national level is incipient. According to Quinteiro *et al.* (2019), there are obstacles to the broader commercialization of the product, including the unavailability of improved techniques for its industrialization. Post-harvest management, such as cleaning, proper storage, processing in the form of flour or starch extraction, preparation of food products, would make the product available at other times of the year and thus expand its supply throughout the country.

In principal components analysis it is observed that the seasonal and cultural/regional aspects located in the first quadrant are in very close positions, indicating a relationship between their terms or words mentioned by the interviewees. This behavior is well explained by the association that the pinhão nut has with the cultural aspects of its origin, in which it is consumed mainly in winter and during regional festivals.

Likewise, the dimensions “Consumption,” “Specie/environment,” and “Food association” reflect that the consumption of this non-wood forest product can be associated with a wide range of gastronomic uses. Thus, pinhão nut can serve as a tool for cultural exchange because its production is restricted to a region in Brazil. This can attract tourists who get to be involved in local customs and understand the unique and authentic characteristics of a specific culture. Additionally, traditional foods contribute to brand identity and increase the attractiveness of the destination. According to Hsu *et al.* (2018) it is possible to promote economic development within regions, support local agro-economics, and avoid the import of expensive foreign food.

The third group with proximities was observed for hedonic attitudes, sensory characteristics, non-sensory characteristics, and health/nutrition dimensions. While the different/unknown group is isolated in the graph due to what was previously observed, there is still a lack of knowledge about this product in the national and international markets. The valuation of pinhão nut as human food and the dissemination of nutritional properties may favor increased consumption and contribute to the conservation of araucaria, reducing deforestation (MARQUES *et al.*, 2021).

Attitudinal questionnaire

The Factor 1 in the questionnaire, brought together issues that address issues such as the consumption of pinhão nut, health benefits, and forms of consumption, knowledge about non-timber forest products, and relevant attributes for purchase.

Factor 2 grouped together questions about the extinction of forests and the role of the government and society in preservation. Factor 3 is linked to issues related to the sale of pinhão nuts, while Factor 4 draws attention to issues related to the extinction of araucarias and the collection of pinhão nuts.

First, it was observed that pinhão nuts are widely consumed in the southern regions of Brazil during winter, and are part of numerous culinary dishes. The strong correlation verified in questions 1 and 3 demonstrates that consumers who know about pinhão nut use it in diverse ways, such as in cooked form, flour, or roast. Despite the numerous delicacies produced, its industrialization is almost nil due to its seasonality and the lack of an industrial culture in the producing regions. This makes it difficult to apply it in different products, in different ways, and for a longer period of time. Additionally, in other regions of the country, pinhão nut is unknown, precisely because of the lack of commercialization at the national level.

Question 15 demonstrated the relationship between consumers and their knowledge of non-timber forest products, indicating that most respondents did not know what these products would be. These data corroborate those of Vuola *et al.* (2018), who studied the NTFP market in the city of Belém do Pará in Brazil from 2006 to 2009. The authors mention that the market that most consumes NTFPs is composed of consumers with higher income and education. However, despite consumption, they are unaware that these products are characterized as

NTFPs and come from forests. More than 75% of respondents indicated Brazil nuts (*Bertholletia excelsa*) and açai (*Euterpe oleracea*) as the most popular products.

The issues related to the important attributes when buying pinhão nut (Q8) and consumers' knowledge about its health benefits (Q5) are also strongly correlated, because the valuation of a product is mainly based on its quality, whether sensory, industrial, nutritional, or technological. To achieve this, farmers must adopt technologies to better connect them to the market and bypass traditional marketing channels, especially those involving middlemen (PERALTA *et al.*, 2016).

Factor 2, with five grouped questions, has the extinction of Araucaria forests and the role of the government and society in their preservation as its theme. Most interviewees believe that there is not enough information to encourage people to preserve their forests. There is a lack of information on a governmental level, and in schools and media (radio, television, internet, social media, newspapers).

In forest regions, it is necessary to establish and/or strengthen partnerships between government agencies designated for the management of natural resources and social actors who live in ecologically important environments so that in addition to environmental preservation, work and income generation and consequent improvement in the quality of life of local farmers are achieved (GUENEAU; DINIZ, 2020).

The negative correlation of questions 12 and 18 refers to the direct connection between the presence and the lack of information on the preservation of ecosystems. Disclosures about sustainability and environmental impact, objectively and reliably encourage more ecologically sustainable choices and behavior by consumers. That is, if consumer choices are positively affected by sustainability information, then sustainable products compete more effectively in the market (CHO *et al.*, 2018).

The relationship in the commercialization of pinhão nut, with prices (Q6), access (Q7), seasonality (Q9) in Factor 3 demonstrates that the economic valuation of a species cannot jeopardize the ecosystem from which it originates, since the growing demand and the increase in prices of a certain non-timber forest product can indeed result in the preservation and increase of the population of a species. However, if not well planned, monitored and constantly reassessed, management can have negative impacts on the environment, as is the case with the exploitation of açai in the Amazon, which has caused drastic changes in the natural environment (TAGORE *et al.*, 2018).

The Factor 4 (Q10, Q11, and Q16) address the interviewees' knowledge regarding the collection of pinhão nut, its origin, and the extinction of forests in Brazil and across the world. It was observed that pinhão nut is related to araucaria forests, but there is no knowledge about how pinhão collection is done.

Pinhão nuts collection is characterized as family labor and is carried out predominantly by people who reside in the surroundings of the remnant araucaria forests. This practice is considered extremely risky as it involves manual activities like climbing araucaria trees by carving them or placing spikes in the carver's shoes. These trees can have an average height of 20 to 50 meters. The pine cones are felled using a bamboo pole (*Bambusa* sp.), measuring approximately five meters. According to De Britto *et al.* (2018), climbing and descending these trees require great physical effort, and these are activities with a high risk of accidents. Additionally, they lead to inappropriate body postures.

Marques *et al.* (2021) mentioned that the exploration of pinhão nut is potentially a conservation tool, but it is necessary that there is a stimulus in the planting of araucarias and research on their phenology and ecology along with rules enforce proper extraction and commercialization.

By examining the responses obtained as a whole, we seek to understand how the consumption of pinhão nut can be used as a catalyst for the conservation of araucaria forests, and simultaneously increase the income and quality of life of farmers who depend on these resources.

The role of multiple actors including local communities, research centers, the government, non-governmental entities, and industries was emphasized, while many questions remain open:

- 1) How much pinhão nuts needs to remain in the natural environment so that its function in the ecosystem is not compromised?
- 2) How much pinhão nuts need to be collected per hectare for the activity to be attractive to farmers?
- 3) What is the value per kg that the farmer finds attractive?
- 4) How will the industry generate high value-added products so that it effectively favors the farmer with a sustainable supply chain while influencing the consumer to take an active role in protecting forests?

An interesting alternative to establishing a path between sustainable family production of pinhão nut and marketing is solidarity economy, which is based on self-management, free and democratic association of those involved, citizen participation, quality of life, and environmental responsibility, seeking gains in a socially just and sustainable way.

Thus, by following the principles of solidarity economy as a market strategy, practices such as local productive arrangements, direct sales, designation of origin, geographical indication, associations, and networks

of producers and consumers can be employed. This adds value and quality to the final product, ensures marketing channels and socio-environmental responsibility.

CONCLUSIONS

- The conservation of araucaria forests requires the integration of different sectors of society.
- The consumption of pinhão nut and its commercialization on national and international levels (not just regionally) can favor the conservation of araucarias and the subsistence of the agricultural communities.
- It is argued that to value pinhão nut as a product, it is necessary to expand its dissemination as a food product.
- It is necessary to make its distribution and commercialization viable beyond the southern region of Brazil.
- The consumer can be an agent of political, environmental, and social change to combat the extinction of forest.

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