Revista de Gestão

Signaling theory and quality cues: the willingness-to-pay for high and low involvement sustainable attributes

Maria Sylvia Macchione Saes
School of Economics, Management, Accounting and Actuarial Sciences, University of São Paulo, São Paulo, Brazil
Eduardo Eugênio Spers
Department of Economy, Administration and Sociology, University of Sao Paulo – Luiz de Queiroz Campus, Piracicaba, Brazil
Elis Regina Monte Feitosa
School of Economics, Management, Accounting and Actuarial Sciences, University of São Paulo, São Paulo, Brazil
Lilian Maluf de Lima
Luiz de Queiroz College of Agriculture, University of Sao Paulo – Luiz de Queiroz Campus, Piracicaba, Brazil, and
Giovana Zamith and Jacques Marcovitch
School of Economics, Management, Accounting and Actuarial Sciences, University of São Paulo, São Paulo, Brazil

Received 20 August 2024
Revised 27 January 2025
23 June 2025
27 August 2025
Accepted 29 August 2025

Abstract

Purpose – With the support of signaling theory the paper investigates the impact of quality cues related to environmental and social sustainability concerns on the purchase intention and willingness to pay for low-involvement products (fresh pirarucu) and high-involvement products (leather from this fish).

Design/methodology/approach – A survey with 483 potential consumers of pirarucu fish in Brazil. Discrete choice analysis to understand preferences and choices from alternatives attributes of pirarucu fish.

Findings – Signaling and quality cues related to environmental and social concerns influence consumer decision differently for high- and low-involvement exotic food.

Originality/value – The link between signaling theory and quality cues explains the preference for different involvement exotic products.

Keywords Signaling theory, Quality cues, Sustainability, Discrete choice, Consumer decision

Paper type Research article

1. Introduction

Signaling theory, originally proposed by Spence (1973) in the context of labor markets, has been widely applied in marketing to explain how firms convey information to consumers under conditions of information asymmetry. In the marketplace, consumers often face uncertainty about product quality prior to purchase, particularly when direct evaluation is

Funding: This work was supported by Fundação de Amparo à Pesquisa do Estado de São Paulo (award number: 2020/08886-1) and the National Council for Scientific and Technological Development (award number: 304233/2023-4).

Revista de Gestão
Vol. 32 No. 4, 2025
pp. 247-266
Emerald Publishing Limited
e-ISSN: 2177-8736
p-ISSN: 1809-2276
DOI 10.1108/REGE-08-2024-0129

difficult. In such scenarios, companies rely on signals – observable cues such as brand reputation, price, packaging, certifications and advertising – to influence consumer perceptions and reduce perceived risk.

The relevance and effectiveness of these signals, however, vary significantly depending on the level of consumer involvement with the product. High-involvement products, such as automobiles, electronics or luxury goods, typically require considerable cognitive effort and information processing prior to purchase. Consumers of high-involvement goods are more likely to seek out and evaluate signals thoroughly, interpreting elements such as brand heritage, expert reviews and quality certifications as credible indicators of product performance and long-term value (Kirmani & Rao, 2000). In these cases, strong and consistent signaling can create competitive advantages and foster brand loyalty.

In contrast, low-involvement products, such as household cleaners, snacks or bottled water, are typically characterized by low perceived risk and minimal decision-making effort. Consumers may rely more on peripheral cues – such as packaging design, brand familiarity or promotional messages – rather than engage in elaborate evaluation of product attributes (Petty & Cacioppo, 1986). For these products, signaling strategies that focus on visibility and heuristic processing (e.g. bright packaging, celebrity endorsements or price discounts) tend to be more effective in influencing purchase behavior.

The quality of a product can influence the food choice process, but only if it is perceived (Grunert, 2006). Quality cues, which are indicators that consumers use to assess product quality, play a significant role in this process. These cues can be both intrinsic (such as taste, texture or appearance) and extrinsic (such as labeling or certification) and are particularly important when related to sustainability. For example, the presence of quality cues on labeling assists consumers in identifying these indicators of product quality (Hess, Visschers, & Siegrist, 2012; Grunert, Will, & Fernández-Celemín, 2010). The concept of quality cues related to sustainability implies that consumers who make environmental or social food choices are more likely to seek information that helps them assess the sustainable attributes of food products (Petrescu, Vermeir, Burny, & Petrescu-Mag, 2022). Environmental attributes consider the preservation of the environment, while socioeconomic attributes relate to income generation and improvements in the lives of those who produce the goods to be consumed (Allen & Prosperi, 2016).

In sum, integrating signaling theory with the quality cues literature provides a robust framework for understanding how consumers infer product quality and how firms can strategically manage cues to shape perceptions. This approach has significant implications for product positioning, brand management and communication strategies in competitive markets.

This article also engages with the literature that explores the factors that influence exotic foods, such as Spina *et al.* (2024) that empirically explores the factors that influence the consumption of mango in Italy, exploring food values, subjective and objective knowledge and sociodemographic aspects. Chen, Zeng, Zhong, and Wang (2023) analyzes avocado-related user-generated content over three years and employs topic modeling and semantic network methods to obtain the mechanism by which exotic food cross borders to appear in local consumers' daily food choices. Regarding sustainability, Tian, Luan, and Wang (2022) finds that the wealthy Eastern cities have more opportunities to enjoy more kinds of and higher quality exotic food and Isaak and Lentz (2020) provide a broad overview of the relevance of different sustainability characteristics for flowers and ornamental plants as well as for fruit and vegetables from a consumer perspective.

An interesting case to investigate is the pirarucu (Arapaima gigas), a fish native to the Amazon that plays a crucial role in the preservation of the biome and in generating income for riverside communities (Castello & Stewart, 2010; Pedroza-Filho *et al.*, 2016). The pirarucu exhibits characteristics of low involvement (Lastovicka & Gardner, 1978; Llagostera, Kallas, Reig, & De Gea, 2019; Del Giudice *et al.*, 2018; Alvarenga, 2018; Marques & Góes, 2019), being a staple food for Amazonian populations, but it also has high involvement because its

noble leather is used in the manufacturing of luxury products (Alvarenga, 2018; Marques & Góes, 2019).

This study investigates whether quality signals related to sustainability influence the purchase intention and willingness to pay for pirarucu, considering both its fresh meat (low involvement) and its manufactured leather (high involvement). Previous research indicates that consumers do not always simultaneously value the social and environmental aspects of a product (Verbeke, Vanhonacker, Sioen, Van Camp, & De Henauw, 2007). The refusal to consume exotic fish, for example, often stems from environmental concerns, such as biome preservation, without considering the interaction between social actions aimed at promoting community well-being and the preservation of natural environments.

However, sustainable management strategies for pirarucu have shown significant potential for income generation and the preservation of Amazon biodiversity (Castello, Stewart, & Arantes, 2011; Freitas, 2019; Santana, Oliveira, Balbino, & Gurgel, 2020; Melgarejo & Luis, 2020). Thus, this paper seeks to answer whether Brazilian consumers perceive and value these quality signals and whether there are differences between high- and low-involvement products in the appreciation of sustainable pirarucu production.

To this end, the research will seek to provide answers to the following questions:

RQ1. Do consumers effectively perceive and value social and environmental sustainability quality cues when purchasing pirarucu from Amazon biome management areas?

RQ2. Is there a difference between consumers of high and low involvement goods in their appreciation of the environmentally and socially sustainable production of pirarucu products?

Integrating signaling theory with quality cue literature elucidates how sustainable attributes are communicated and interpreted in consumer markets. For marketers, the challenge lies in crafting signals that are both visible and credible, aligning with consumer expectations and regulatory standards. For scholars, this intersection offers fertile ground for exploring how visual, textual and contextual cues coalesce to shape sustainable choice under varying degrees of consumer information and motivation.

Following this introduction, the second section of the article explores the literature review and the third the discrete choice analysis methodology using a logit model. The fourth and fifth sections present the discrete choice analysis associated with pirarucu and the discussion of the results, aligning them with the literature on sustainably managed products. Finally, the study proposes public and private communication actions to enhance quality perception and influence the choice of exotic products from high environmental risk regions.

2. Literature review

A key implication of signaling theory in this context is that the credibility and cost of signals must be aligned with consumer expectations and the product's involvement level. High-involvement products benefit from high-cost, high-credibility signals (e.g. extensive warranties and premium pricing), whereas low-involvement goods may succeed through frequent and accessible signals that leverage brand recall and ease of recognition.

In summary, signaling theory provides a robust framework for understanding how firms can strategically communicate product quality in different consumer decision-making contexts. The efficacy of specific signals depends on whether the product demands high or low consumer involvement, shaping how information is processed and how purchase intentions are formed.

In food consumer behavior and marketing, this theoretical framework is particularly relevant for understanding how consumers assess product quality under conditions of information asymmetry. When direct experience with a product is not feasible prior to

purchase, consumers rely on quality cues – tangible or intangible attributes that serve as signals of product quality.

Quality cues are generally categorized as intrinsic (e.g. physical features such as color, size and texture) and extrinsic (e.g. brand name, price, packaging and country of origin) (Olson & Jacoby, 1972; Steenkamp, 1989). These cues function as proxies for unobservable qualities, such as taste, durability or performance, particularly in contexts of credence or experience goods, where quality cannot be fully verified even after consumption (Nelson, 1970). From a signaling perspective, firms strategically design and manage these cues to reduce uncertainty and convey favorable information about product quality to potential buyers (Kirmani & Rao, 2000).

Toussaint, Cabanelas, and González-Alvarado (2021) suggest that consumers are sensitive to social abuse practices, but they face difficulties to access information in order to inform their decisions. Consumer purchase intention is influenced by a combination of socioeconomic, cultural and demographic characteristics as well as the intrinsic and extrinsic attributes of products (Grunert, Loose, Zhou, & Tinggaard, 2015; Masi, Di Pasquale, Pauselli, Tribilustova & Adinolfi, 2022; Bimbo *et al.*, 2022; Menozzi *et al.*, 2020). In recent years, quality signals related to environmental and social sustainability have gained increasing relevance, directly impacting consumer purchasing decisions and willingness to pay (Kajale & Becker, 2014; Bulsara & Trivedi, 2023; Ateş, 2021; Yang, Hobbs, & Natcher *et al.*, 2020).

For a signal to be effective, it must be observable, costly to fake and reliably correlated with the unobservable quality it represents (Spence, 1973). In this regard, brand reputation operates as a strong quality signal because it is built over time and difficult to replicate by low-quality competitors. Similarly, price often functions as a high-effort signal, with premium pricing interpreted as an indicator of superior quality (Rao & Monroe, 1989). Packaging design and labeling, especially in food and consumer goods, also serve as visual and cognitive signals that influence perceptions of freshness, healthiness and product value (Underwood & Klein, 2002).

Moreover, the signaling efficacy of a given cue depends on consumer involvement and prior knowledge. High-involvement products tend to engage in systematic processing of cues, while low-involvement consumers may rely more on heuristic signals such as brand or package attractiveness (Petty & Cacioppo, 1986). Therefore, marketers must align signal design with target audience characteristics and consumption contexts to ensure optimal cue effectiveness.

In recent years, the increasing relevance of sustainability in consumer behavior has necessitated a deeper understanding of how individuals interpret product information related to environmental and ethical attributes. Signaling theory (Spence, 1973) offers a valuable framework for analyzing this phenomenon, positing that in contexts of information asymmetry, sellers use observable attributes (signals) to convey unobservable qualities of a product to buyers. In sustainability-oriented markets, where intrinsic attributes such as environmental impact or ethical sourcing are often not directly observable, external cues serve as vital signals to communicate product quality and credibility (Kirmani & Rao, 2000).

Quality cues – both intrinsic (e.g. product color and texture) and extrinsic (e.g. brand, labels and packaging) – play a pivotal role in shaping consumer perception of sustainable products (Olson & Jacoby, 1972; Steenkamp, 1989). Eco-labels, certifications (such as organic or fair trade) and packaging claims (e.g. "carbon neutral") function as sustainability signals that help consumers infer the underlying ethical or environmental performance of a product. These signals are especially important in the context of credence goods, where consumers cannot easily verify claims even after purchase.

The effectiveness of sustainability signals is moderated by consumer involvement and prior knowledge. Highly involved consumers are more likely to scrutinize quality cues and differentiate between strong and weak signals, while less involved consumers may rely on heuristics or more salient cues, such as green-colored packaging or well-known certifications (Grunert *et al.*, 2015). Additionally, perceived credibility of the source – whether

governmental, third-party or brand-sponsored – affects the strength of the signal and, ultimately, the purchase decision.

3. Methods

A quantitative analysis was conducted in the form of a survey (via Google Forms), with the collection of structured data through a questionnaire addressed to potential consumers of pirarucu fish in Brazil, creating a non-probability sample of reference chains. The instrument was circulated between March 28 and April 30, 2022 and 483 valid responses were collected.

The discrete choice analysis to understand and model aggregate preferences and choices when faced with discrete alternatives for the specific consumption of pirarucu. Questions were presented regarding the fish as food as well as questions referring to its leather.

Cards were presented to respondents with four attributes (see attachment): (i) Product: fish meat (salmon, pirarucu and tilapia) and wallet; (ii) Price: fish meat (R$20, R$40 and R$50) and wallet (R$50, R$100 and R$400); (iii) Presentation: fish meat (fillet, with skin and in pieces) and wallet (bovine leather, synthetic leather and pirarucu leather); (iv) Certification: fish meat (origin guarantee, antibiotic-free, social impact) and wallet (origin guarantee, social impact and uncertified).

The choice of tilapia is justified by it being the most consumed fish in Brazil, with 2.84 kg/year per capita, representing about 28% of the total fish consumption (10.19 kg/year), reflecting its popularity and accessibility (Peixe BR, 2021). The choice of salmon, on the other hand, is due to its positioning as a sophisticated fish, widely present in high-end restaurants. The growing consumption is evidenced by the increase in imports, highlighting its preference among more discerning consumers (Pinho, 2024). The choice of the 'wallet' product as a representative of high-involvement products was made due to its unisex nature, common usage, easy price availability and greater homogeneity. In contrast, bags and footwear are more versatile products with more heterogeneous prices, depending on size, style and gender and they also offer a wider range of options.

The fish meat price values used in the experiment visualization were based on research conducted on sales websites for these meats in 2023. The websites belonged to the following companies: Swift, Bemol and Cocar & Co. Once the high-involvement product was defined as a wallet, the visualization prices were determined through price research on websites selling leather wallets (bovine, synthetic and pirarucu), such as Agali, Osklen and HLOS.

By arranging the cards according to preferences, the importance of each attribute and the most effective combinations could be determined.

Two models were used for the analysis (Model 1 and Model 2): the first for the "Fish as Food" product (low involvement) and the second for the "Leather Wallet" product (high involvement). These models were derived from the results obtained from the discrete choice analysis and the information from the respondent profile and Likert-scale section questions. To ensure the measurement of the elements in the questionnaire, the Likert scale, which is already validated in the literature and aligns with the measurement objectives of each variable considered, was used. If this scale is perceived as equidistant, as it was in this study, parametric methods can obviously be used to analyze the data (Lantz, 2013; Silva, Marins, Melo, & Silva, 2021).

Logistic regression was used, which allows estimating the probability associated with the occurrence of a particular event based on a set of explanatory variables (Stock & Watson, 2004) and aims to understand the differences between certain groups and the probability that an individual or group belongs to a given category (Ulkhaq *et al.*, 2018).

Thus, for the first model regarding pirarucu fish, we have (Model 1):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{18} X_{18} + u_t \quad (1)$$

Y is the binary variable, where Y = 1 characterizes the interviewee who chose the product (right or left) with its respective attributes displayed on the Fish card; Y = 0 otherwise (i.e. when the interviewee did not choose either the right or left product on the slide), $\beta_0, \beta_1, \beta_2, \ldots, \beta_{18}$, are the parameters of the model to be estimated (coefficients) and u_t refers to the stochastic error term. The values assumed by X are described in Table 1.

For the "Pirarucu Accessory" model (wallet), we have (Model 2):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{17} X_{17} + u_t \quad (1)$$

Table 1. Low involvement model – fish meat

Variable	Code	Description
X_1_2	FISAL	Fish type: Salmon
X_1_2	FIPIRA	Fish type: Pirarucu
X_1_3	FITILA*	Fish type: Tilapia
X_2_1	SKIN*	Fish presentation: With skin
X_2_2	PIECES	Fish presentation: In pieces
X_2_3	FILLET	Fish presentation: Fillet
X_3	PRICE	Desired price: R$20.00, R$40.00 or R$50.00
X_4_1	FREE	Production process: Antibiotic-free
X_4_2	GUAORI*	Production process: With origin guarantee
X_4_3	IMPAC	Production process: With positive social impact
X_5_1	GENDER1	Gender: Female
X_5_2	GENDER2*	Gender: Male
X_6	SCHOOL	Education level: integer values from 1 to 7 1 – Incomplete elementary school; 2 – Completed elementary school; 3 – Incomplete high school; 4 – Completed high school; 5 – Incomplete college/university; 6 – Completed college/university and 7 – Postgraduate
X_7	INCOME	Income level: integer values from 1 to 4 1 – income from 1 to 2 minimum wages; 2 – income from 2 to 4 minimum wages; 3 – income from 4 to 10 minimum wages and 4 – income more than 10 minimum wages
X_8	LIMITUS	Conscious effort to limit the use of scarce products (seven-point Likert Scale)
X_9	SUBSTI	Substitution of products/brands for ecological reasons (seven-point Likert Scale)
X_10	LESSHAR	Preference for products less harmful to others and/or the environment (seven-point Likert Scale)
X_11	ENHARPR	Influence on family members or friends to not buying environmentally harmful products (seven-point Likert Scale)
X_12	WITHLEG	Check if purchased brands comply with environmental legislation (seven-point Likert Scale)
X_13	RIMPAC	Preference for food from producers that reduce environmental impact (seven-point Likert Scale)
X_14	INVDES	Concern about food's involvement with deforestation in the Amazon (seven-point Likert Scale)
X_15	PROTRAS	Preference for animal protein from brands with traceable origin (seven-point Likert Scale)
X_16	CONTPRO	Seeking products from companies that direct part of their profits to environmental conservation projects (seven-point Likert Scale)
X_17	PAYWEN	Willingness to pay more for food that considers the welfare and quality of life of small producers and thus ensures the preservation of the environment (integer values from 1 to 5;1 – from 0 to 10%; 2 – from 10 to 25%; 3 – from 25 to 50%; 4 – from 50 to 75% and 5 – from 75 to 100%)
X_18	KNOWP	Knowledge about the origin and production (seven-point Likert Scale)

Note(s): * base or reference category (omitted): FITILA, SKIN, GENDER2 and GUAORI

Source(s): Search data (2022)

Y is the binary variable, where Y = 1 characterizes the interviewee who chose the product (right or left) with its respective attributes displayed on the Fish card; Y = 0 otherwise (i.e. when the interviewee did not choose either the right or left product on the slide), $\beta_0, \beta_1, \beta_2, \ldots, \beta_{17}$, are the parameters of the model to be estimated (coefficients) and u_t refers to the stochastic error term. The values assumed by X are described in Table 2.

It should be emphasized that the variables in both models were found to be significant (p-values<0.05). The analyses of the models were based on evaluating the marginal effect caused by the coefficients of the explanatory variables on the dependent variable. Other models were estimated considering the presence of additional variables using the stepwise method, and with the aid of the lowest Akaike Information Criterion (AIC) value, the most robust model (best statistical fit) was selected for each stage.

The equation below represents the stepwise method [1]:

Table 2. High involvement model – wallet

Variable	Code	Description
X_1_2	LEATART*	Leather: Synthetic leather
X_1_2	LEATBOV	Leather: Bovine leather
X_1_3	LEATPIR	Leather: Pirarucu leather
X_2	PRICE	Desired price: R$50.00, R$100.00 or R$400.00
X_3_1	FREE*	Production process: with no origin certificate
X_3_2	GUAORI	Production process: With origin guarantee
X_3_3	IMPAC	Production process: With positive social impact
X_4_1	GENDER1	Gender: Female
X_4_2	GENDER2*	Gender: Male
X_5	SCHOOL	Education level: integer values from 1 to 7 1 – Incomplete elementary school; 2 – Completed elementary school; 3 – Incomplete high school; 4 – Completed high school; 5 – Incomplete college/university; 6 – Completed college/university and 7 – Postgraduate
X_6	INCOME	Income level: integer values from 1 to 4 1 – income from 1 to 2 minimum wages; 2 – income from 2 to 4 minimum wages; 3 – income from 4 to 10 minimum wages and 4 – income more than 10 minimum wages
X_7	LIMITUS	Conscious effort to limit the use of scarce products (seven-point Likert Scale)
X_8	SUBSTI	Substitution of products/brands for ecological reasons (seven-point Likert Scale)
X_9	LESSHAR	Preference for products less harmful to others and/or the environment (seven-point Likert Scale)
X_10	ENHARPR	Influence on family members or friends to not buying environmentally harmful products (seven-point Likert Scale)
X_11	WITHLEG	Checking if purchased brands comply with environmental legislation (seven-point Likert Scale)
X_12	RIMPAC	Preference for food from producers that reduce environmental impact (seven-point Likert Scale)
X_13	INVDES	Concern about food's involvement with deforestation in the Amazon (seven-point Likert Scale)
X_14	PROTRAS	Preference for animal protein from brands with traceable origin (seven-point Likert Scale)
X_15	CONTPRO	Seeking products from companies that direct part of their profits to environmental conservation projects (seven-point Likert Scale)
X_16	PAYWEN	Willingness to pay more for food that considers the welfare and quality of life of small producers and thus ensures the preservation of the environment (integer values from 1 to 5 1 – from 0 to 10%; 2 – from 10 to 25%; 3 – from 25 to 50%; 4 – from 50 to 75% and 5 – from 75 to 100%)
X_17	KNOWP	Knowledge about the origin and production processes (seven-point Likert Scale)

Note(s): * base or reference category (omitted): LEATART, GENDER2 and FREE

Source(s): Search data (2022)

$$AIC = -2log\,log\left(L_p\right) + 2[(p+1)+1] \quad (2)$$

where Lp is the maximum likelihood function, and p is the number of explanatory variables in the model.

Additionally, a way to assess the adequacy of logistic regression to the data is using indicators known as pseudo R-squared. According to Hair, Black, Babin, Anderson, and Tathan (2009), they serve a similar purpose as R-squared in linear regression, representing the proportion of variation in the dependent variable explained by the model, and can be used to compare the performance of competing models between two equally valid logistic equations. In this regard, the model with the highest pseudo R-squared should be preferred. This criterion, along with AIC and stepwise, was adopted in choosing the most robust model at each stage.

In addition to the discrete choice analysis models for the high- and low-involvement products, we also estimated two logit models (models A and B) to obtain the willingness to pay (WTP) for the products presented to the respondents. Literature brings several ways to calculate and obtain WTP, by direct or indirect means.

According to Belluzzo Junior (1999), there seems to be a consensus that indirect methods are closer to the real market because they present a good and a price, and the consumer can buy it or not. This is the method used in this study to obtain the WTP, classified as declared or stated WTP (Silva, 2003).

This technique of obtaining WTP provides only an indication of the true willingness to pay (true WTP), as the way questions are presented produces a set of values that may not represent the true WTP. Thus, we calculate the estimated WTP using the coefficients from the logit model for the two products (wallet and fresh fish). This model allows the estimation of the true stated willingness to pay (Silva, 2003; Hadker, Sharma, David, & Muraleedharan, 1997).

These models comprise only variables visualized in the slides presented to the respondents. Thus, Model A (Appendix 1) presents the variables referring to fish type ("salmon," "pirarucu" and "tilapia"), fish presentation ("with skin," "in pieces" and "fillet"), desired price ("R$ 20.00," "R$ 40.00" and "R$ 50.00") and production process ("antibiotic-free," "with origin guarantee" and "with social impact"); Model B (Appendix 1) presents the variables: kind of leather ("synthetic," "bovine" and "pirarucu"), desired price ("R$ 50.00," "R$ 100.00" and "R$ 400.00") and production process ("no origin certificate," "with origin guarantee" and "with social impact").

The operationalization of the modeling for estimating the true WTP followed the same methodology described in Belluzzo Junior (1999) and Silva (2003). The WTP value occurs as the sum of all the mean coefficients of the estimated logit model multiplied by the mean (or median) value of the respective explanatory variables (attributes), including the intercept. This amount is then divided by the estimated coefficient of the variable "PRICE" (Silva, 2003, p. 67). Similar methodology is presented by Hadker *et al.* (1997) and Belluzzo Junior (1999).

4. Results

This section brings research results in order to respond to RQ1 (Do consumers effectively perceive and value social and environmental sustainability quality cues when purchasing pirarucu from Amazon biome management areas?).

4.1 Respondent profile

Table 3 provides a summary of the respondent profile. Brazil is divided into five regions: South (S), Southeast (SE), North (N), Northeast (NE) and Midwest (M). The distribution of respondents across these regions is somehow aligned to the population, except for the South region (over-represented) and the Northeast region (under-represented). The Southeast region has the highest purchasing power according to HDI. Regarding income, as observed, our sample does not correspond to the population, as the majority of respondents have monthly

Table 3. Respondent profile

		Respondents (%)	Population (%) *	HDI**
Region	South	5%	14%	0.754
	Southeast	58%	42%	0.766
	Midwest	10%	8%	0.757
	Northeast	14%	27%	0.663
	North	13%	9%	0.667
Income***	Up to 1 minimum wage	1%	33%	–
	Between 1 and 2 minimum wages	11%	35%	–
	Between 2 and 3 minimum wages	10%	More than 2 minimum wages (32%)	–
	Between 3 and 4 minimum wages	35%		–
	Above 4 minimum wages	43%		–
Gender	Male	48%	49%	–
	Female	52%	51%	–
Age Group[#]	17–26 (Z generation)	29%	24%	–
	27–42 (X generation)	44%	34%	–
	43–58 (Millennials)	21%	26%	–
	59–74 (Baby Boomer)	6%	16%	–

Note(s): * IBGE (2019), ** Human Development Index; *** Monthly minimum wage of R$1,212 is equivalent to US$214.89 (1 USD = 5.64, April 2023); [#] Baby Boomer (born 1946–1964); Genaration X (born 1965–1980); Generation Y or Millennials (born 1981–1996) and Generation Z (born 1997–2010) – ENEL (2024), available at: https://www.enelgreenpower.com/pt/learning-hub/gigawhat/pesquisar-artigos/articles/2024/05/classificacao-geracoes-x-y-z-alfa. [##]ITAU BBA, 2020. Millennials Unraveling The Habits of Generation Y in Brazil

Source(s): Search data (2022)

earnings higher than three minimum wages. It is worth noting that per capita fish consumption is higher in households from the North region, with 17.70 kg/year, followed by households in the Northeast region, with 8.25 kg/year. In these two regions, fish consumption is part of the population's habits. Per capita consumption in the other regions is as follows: Midwest (3.69 kg), South (3.36 kg) and Southeast (2.73 kg) (Instituto Brasileiro de Geografia e Estatística – IBGE, 2019). However, this bias is desirable, as we are analyzing a product targeted at higher-income consumers.

The Southeast region has the second-highest potential for fish consumption, as only 10% of respondents from this region claim to never consume fish, and 51% state that they consume fish at least once a week. In addition to the considerable fish consumer market, consumers in the Southeast already show some familiarity with pirarucu, as only 15% claim to be unaware of it, albeit over 60% have never tasted it.

According to Table 4, only 8.1% of respondents indicate relying on certifications as means for identifying sustainable products. This can be attributed to the limited availability of sustainability seals in the Brazilian market. The most prevalent methods for identifying sustainable products across all categories are recommendations from friends or family, followed by assessing the packaging appearance.

Regarding the determining factors in the purchase of leather accessories from Amazon, the most important item considered was brand (82.4%), followed by comfort and durability. Environment concern came in position (32.5%).

4.2 Discrete choice analysis of pirarucu consumption

In order to answer RQ2 (whether there is a difference between consumers of high- and low-involvement goods in regards to the appreciation of the environmentally and socially

Table 4. Determining factors in purchase decision

Determining factors: Sustainable products and leather accessories			
In finding/recognizing sustainable products	%	In the purchase of Amazonian fish leather accessories	%
Seal (Certification)	8.1%	Brand	82.4%
Seller's advertising	57.6%	Product cosmetic appeal	34.0%
Packaging appearance	63.6%	Environmental concern	32.5%
Recommendation from friends or family	69.4%	Comfort and durability	37.3%
Recommendation from influencers on the internet	49.9%	Increase in income for riverside producers	21.5%
Other factors	7.6%	Other factors	13.9%

Note(s): In both questions the respondent could choose more than one alternative
Source(s): Research data (2022)

sustainable production of pirarucu products), we proceeded with the Logit model for high and low involvement (Table 5).

The results obtained from fitting the Logit model for fish (pirarucu, salmon and tilapia) are presented in Table 5 as Model 1. Regarding the predicted values obtained from the estimated model, an accuracy index is obtained by comparing them to the observed values from the sample. For the model on hand, this index shows an agreement percentage of 80.03%, considered a good fit according to Pino (2007).

The factor that negatively influences purchasing the most is the female gender (−4.12%), followed by checking if purchased brands comply with environmental legislation (−3.93%). On the other hand, the factors that most contribute to probability of purchase are connected to product presentation – fillet (10.08%) and pieces (7.53%), followed by production process with origin guarantee (6.91%).

As expected (H1), for the low-involvement product (pirarucu meat), the probability of choosing the exotic product (pirarucu fish, $p < 0.05$) is lower than a more familiar product to the consumer, such as salmon ($p < 0.01$), in relation to tilapia (base category). The probability of choice also increases with higher income and higher education level and decreases with the female gender.

Results show that consumers' wish for products from producers who aim to reduce the environmental impact of their activities – such as conserving riparian forests and promoting reforestation of native forests – (variable RIMPAC) is significant ($p < 0.055$) for the decision of choosing fresh fish (pirarucu, salmon and tilapia). Choice is also significantly affected when consumers are concerned about whether the food they consume is associated with deforestation in the Amazon (INVDES, $p < 0.05$) and when they purchase animal protein from brands that allow origin tracing (PROTRAS, $p < 0.05$).

Table 5 also describes the results obtained for the manufactured product (high-involvement). Similar to what was found for the low-involvement product, (H2) the probability of choosing the manufactured product with exotic leather, the pirarucu wallet, is lower than a product that is more familiar to consumers, such as the bovine leather wallet, reflecting the fact that it is more easily found in the market, as opposed to a wallet made from an exotic product like pirarucu (−5.6%).

As we can see, the response to the question regarding environmental and social perception was significant for both low-involvement and high-involvement products (WITHLEG, RIMPAC, INVDES, CONTPRO, PAYWEN, LESSHAR and KNOWP), although, as expected, the environmental impact is higher for high-involvement products. As for the question of origin assurance (GUAORI), the impact for low-involvement products was 6.91% than 24.79% for high-involvement products.

Table 5. Estimates of coefficients and values of marginal effects from Logit model** for fresh fish (pirarucu, salmon and tilapia) and wallet

	Coefficients		Marginal effects			Fish meat		Manufactured product		Descriptive statistics	
Variables (code)	Fish meat (Model 1)	Manufactured product (Model 2)	Fish meat (Model 1)	Manufactured product (Model 2)	Difference[#] (%)	Wald value	*p*-value	Wald value	*p*-value	Mean	Standard deviation
Intercept	−0.1224	0.6027	–	–	–	–	–	–	–	–	–
PRICE (FISH)	−0.0072	–	−0.0011	–	–	5.5595	0.0184	–	–	35.14	12.36
PRICE (WALLET)	–	−0.0032	–	−0.00067	0.04	–	–	216.9965	0.0000	153.90	143.65
WITHLEG[***]	−0.2614	−0.2636	−0.0393	−0.05569	−1.63	50.6202	0.0000	67.6575	0.0000	4.41	1.87
LIMITUS[***]	−0.0733	0.0400	−0.0110	0.00845	1.94	6.1213	0.0133	2.4185	0.1199[*]	4.94	1.72
SUBSTI[***]	−0.0830	−0.0446	−0.0125	−0.00942	0.31	8.6150	0.0033	3.0645	0.0800	4.97	1.94
LESSHAR[***]	0.0799	0.1186	0.01203	0.0250	1.30	6.6590	0.0098	18.3925	0.0000	5.22	1.76
ENHARPR[***]	0.1165	−0.0799	0.0175	−0.0168	−3.43	25.4736	0.0000	15.0346	0.0001	4.04	2.08
RIMPAC[***]	0.0811	0.2203	0.0122	0.0465	3.43	3.6887	0.0548[*]	35.3419	0.0000	4.51	1.80
INVDES[***]	−0.0977	−0.0838	−0.0147	−0.0177	−0.30	8.5210	0.0035	7.2704	0.0070	4.26	1.95
PROTRAS[***]	0.2312	−0.0537	0.0348	−0.01134	−4.61	95.1037	0.0000	6.3075	0.0120	3.54	1.90
PAYWEN	−0.1914	−0.1688	−0.0288	−0.0356	−0.68	32.5603	0.0000	33.3789	0.0000	2.25	1.15
CONTPRO[***]	0.0841	0.0885	0.0126	0.0187	0.61	9.1915	0.0024	12.1250	0.0005	4.35	1.84
GUAORI[#]	0.4736	1.2767	0.0691	0.2479	17.88	26.4908	0.0000	216.9965	0.0000	–	–
IMPAC	0.3596	0.8659	0.0520	0.17399	12.20	14.2651	0.0001	117.695	0.0000	–	–
KNOWP[***]	−0.0110	0.0277	−0.0016	0.0058	0.74	0.1457	0.7026[*]	1.2328	0.2669[*]	4.30	1.86
GENDER_1	−0.2752	−0.2271	−0.0412	−0.0478	−0.66	12.0528	0.0005	11.5539	0.0007	–	–
SCHOOL	0.0958	0.0482	0.0144	0.0101	−0.43	5.8610	0.0155	1.9895	0.1585[*]	–	–
INCOME	0.2871	0.0685	0.0432	0.0144	−2.88	74.5713	0.0000	5.8350	0.0157	–	–
FIPIRA	0.2080	–	0.0305	–	–	5.0217	0.0250	–	–	–	–
FISAL	0.3242	–	0.0474	–	–	12.2232	0.0004	–	–	–	–
PIECES	0.5275	–	0.0753	–	–	32.6371	0.0000	–	–	–	–
FILLET	0.7079	–	0.1008	–	–	57.5246	0.0000	–	–	–	–
LEATBOV	–	−0.1190	–	−0.02535	–	–	–	2.0907	0.1482[*]	–	–
LEATPIR	–	−0.2639	–	−0.0566	–	–	–	11.1487	0.0008	–	–

(*continued*)

Table 5. Continued

Variables (code)	Coefficients: Fish meat (Model 1)	Coefficients: Manufactured product (Model 2)	Marginal effects: Fish meat (Model 1)	Marginal effects: Manufactured product (Model 2)	Difference[#] (%)	Fish meat: Wald value	Fish meat: *p*-value	Manufactured product: Wald value	Manufactured product: *p*-value	Descriptive statistics: Mean	Descriptive statistics: Standard deviation
*Fit indexes***											
Pseudo R^2 (Cox Snell) – Model 1											0.0875
Pseudo R^2 (Nagelkerke) – Model 1											0.1364
Pseudo R^2 (Cox Snell) – Model 2											0.1347
Pseudo R^2 (Nagelkerke) – Model 2											0.1877
AIC – Model 1											4556.6
AIC – Model 2											5831.7
n – Model 1											4834 obs
n – Model 2											5174 obs
% accuracy – Model 1											80.03%
% accuracy – Model 2											71.02%

Note(s): [#] Difference between marginal effects (model2 – model1); *not significant (significance above 10%) and n corresponds to the sample size of the data

[**]Model 1: low-involvement product (fresh fish) and Model 2: high-involvement product

[***]Likert Questions: the respondents had to indicate their level of agreement or disagreement on a 7-point scale (1 = strongly disagree; 2 = disagree; 3 = slightly disagree; 4 = neither agree nor disagree; 5 = slightly agree; 6 = agree and 7 = strongly agree) in response to the statements

Source(s): Data search (2023)

The results also confirmed that the probability of choosing the fish leather wallet is significant ($p < 0.01$) and higher (4.65% compared to 1.22% for the low-involvement product) when consumers seek products from producers who aim to reduce the environmental impact of their activities (variable RIMPAC). It was also significant ($p < 0.01$) and almost the same probability of choice (−1.5% and −1.1%) when consumers are concerned about whether the food they consume is associated with deforestation in the Amazon (INVDES, $p < 0.05$). Lastly, the probability of purchasing brands that allow origin tracing was significant (PROTRAS, $p < 0.01$) and is higher for low-involvement products compared to high-involvement products.

Influence on family members or friends not to buy environmentally harmful products (ENHARP) was significant for both low-involvement and high-involvement products; however, in model 1 there was an increase of 1.75% in the probability of choosing the fresh product, whereas in model 2 there was a reduction of 1.68%.

About the production process, it is interesting to note that the presence of guarantee of origin (GUAORI) and low social impact (IMPAC) for fresh fish show a higher probability of choice when compared to the absence of antibiotic (reference category). The marginal effects for these variables are +6.9 and +5.2%, respectively.

Finally, Table 5 presents means and standard deviations (descriptive statistics) of the sustainability-related Likert questions.

Considering that the product under study is not just any pirarucu specimen but specifically those produced in the Amazon, following sustainability and fair remuneration principles, a set of the Likert scale questions deserves an additional analysis because it addresses sustainable consumption in general and specific issues of the research focus.

The claims "preference for products less harmful to others and/or the environment (LESSHAR)" and "substitution of products/brands for ecological reasons (SUBSTI)" denote the highest scale means, 5.22 and 4.97, respectively. It is possible to notice an inclination to change consumption habits towards products with low environmental impact (a sign of propensity for sustainable consumption).

The statements "I am concerned about knowing whether the food I consume is involved in deforestation in the Amazon (INVDES)" (4.26) and "I seek to know if the brands I buy comply with current environmental legislation (WITHLEG)" (4.41) indicate that there are sustainable products that could be better positioned with more information, as there is a willingness/concern among respondents to acquire them. The lack of quality cues (such as certifications) may be inhibiting passive consumers from seeking sustainable products from Amazon. In this regard, strengthening the certification work can be a key step in expanding the market for consumption of fish raised in the Amazon through sustainable management.

On the other hand, the variable that presented the lowest average was "preference for animal protein from brands with traceability of origin (PRORAS)" (3.54). Despite a value below 5, it should be noted that it impacts the opposite of the product of high involvement (negative marginal effect, −1.13%) and low involvement (positive marginal effect, +3.48%).

4.3 Willingness to pay (WTP)

The coefficients for calculating the estimated WTP result from logit models for fresh fish (Model A) and wallet (Model B). These models comprise only variables visualized in the slides presented to the respondents.

Table 6 shows the coefficients of Models A and B, which are important in the use of the estimated WTP.

With the coefficients from Models A and B, we have the estimated WTPs for fresh fish and wallet, respectively (Table 7).

5. Discussion

In our study focused on sustainably managed low-involvement product (fresh fish), we starting from the tilapia with skin, no guarantee of origin and with positive social impact.

Table 6. Coefficients of models A and B for calculating the estimated WTP, for fresh fish and wallet, respectively

Variables (code)	Fresh fish Coefficients (Model A)	Wallet Coefficients (Model B)	Fresh fish Wald value	*p*-value	Wallet Wald value	*p*-value
Intercept	0.7470	0.5996	–	–	–	–
PRICE	−0.0077	−0.0032	5.35	0.0206	239.00	0.0000
GUAORI	0.4347	1.2714	27.18	0.0000	244.98	0.0000
IMPAC	0.3182	0.8747	14.77	0.0001	127.24	0.0000
FIPIRA	0.2001	–	5.34	0.0208	–	–
FISAL	0.3613	–	12.44	0.0004	–	–
PIECES	0.4910	–	32.03	0.0000	–	–
FILLET	0.6783	–	56.71	0.0000	–	–
LEATBOV	–	−0.0833	–	–	1.087	0.2971*
LEATPIR	–	−0.2439	–	–	10.02	0.0015
Fit indexes						
Pseudo R^2 (Cox Snell) – Model A						0.0183
Pseudo R^2 (Nagelkerke) – Model A						0.0285
Pseudo R^2 (Cox Snell) – Model B						0.0926
Pseudo R^2 (Nagelkerke) – Model B						0.1291
AIC – Model A						4881.9
AIC – Model B						6049.3
n – Model A						4834 obs
n – Model B						5174 obs
% accuracy – Model A						21
% accuracy – Model B						69

Note(s): *not significant (significance above 10%)

Source(s): Search data (2022)

Under these conditions, we obtained an estimated WTP of US$ 19.40. When we compare this value to the pirarucu fish, under the same conditions as the base fish (tilapia), we have an increase of 26.78% in WTP. Consequently, the incremental WTP associated with the guarantee of origin and the guarantee of positive social impact was found to be 85 and 69%, respectively.

For the high-involvement product, we estimate the WTP of US$37.35; in this case, the base product is a synthetic leather wallet, with no guarantee of origin and no positive social impact. Based on this value, if the wallet is made of pirarucu leather with a guarantee of origin, the increase in the base WTP is approximately 172%; if the pirarucu wallet embodies a guarantee of positive social impact instead of a guarantee of origin, the increase is 105%. It is interesting to note that if the wallet is made of pirarucu leather, with no guarantee of origin and positive social impact, there is a reduction in WTP of about 41% versus the base product.

Table 7 also brings the ranges of stated or declared WTP by region of Brazil.

In our investigation of sustainably managed wild pirarucu production, we inquired about respondents' willingness to pay a premium price for products that prioritize the well-being and quality of life of small producers while ensuring environmental preservation. The findings presented in Table 7 reveal that the origin region of pirarucu exhibited the biggest percentage (50–75%), despite it having the lowest-income population according to Table 3. Interestingly, the biggest part of respondents in every region expressed a willingness to pay a premium price ranging from 10 to 25%.

When we analyze the estimated WTP, we notice that the attributes guarantee of origin and positive social impact confer a significant increase to WTP, over 100%. High-involvement product presents practically double this value if than fresh fish (low-involvement).

Table 7. WTP estimated and stated – fresh fish (low-involvement) and wallet (high-involvement) from logit Model A and B, respectively

Low involvement				Estimated WTP	
Base: tilapia with skin, antibiotic-free, no origin guarantee, no social impact guarantee (US$19.40)*				%	ΔUS$
pirarucu + skin				+26.78	+5.19
pirarucu + skin + origin guarantee				+84.97	+16.48
pirarucu + skin + guarantee of positive social impact				+69.38	+13.46
Hight involvement				estimated WTP	
Base: wallet with artificial leather, without origin certificate, without origin guarantee, without social impact guarantee (US$37.35)*				%	ΔUS$
wallet with pirarucu leather				−40.81	−15.24
wallet with pirarucu leather + origin guarantee				+171.93	+64.21
wallet with pirarucu leather + guarantee of positive social impact				+105.55	+39.42
Willingness to pay a premium price for sustainable products (declared WTP)	0–10%	10–25%	25–50%	50–75%	75–100%
respondents in the South region (S)	33%	50%	13%	4%	–
respondents in the Southeast region (SE)	31%	41%	15%	8%	5%
respondents in the Midwest region (MW)	30%	39%	13%	3%	15%
respondents in the Northeast region (NE)	25%	39%	20%	11%	5%
respondents in the Northern region (N)	15%	38%	21%	15%	11%
OVERALL (Brazil)	27%	41%	16%	8%	7%

Note(s): *The estimated WTP (R$) of fresh fish and wallet considers exchange rate of 1 Dollar = 5 Reais
Source(s): Search data (2022)

In general, the results indicate that consumers perceive and value social and environmental sustainability quality cues, as they are willing to pay a premium for sustainable products that contribute to the protection of the Amazon rainforest. However, respondents tend to consume tilapia, a product from fish farming, with the exception of the Northern region. Price also plays a relevant role, considering that fish prices in the northern region are more accessible, which may influence consumption in the region.

Therefore, strategies that value sustainability, certification and promotion of pirarucu, alongside actions to make the product more accessible and attractive to consumers, can boost consumption of the species and contribute to the preservation of the Amazon. In this sense, these results partially confirm the findings of Verbeke *et al.* (2007) and Signes, Miret-Pastor, Tsiouni, Siggia, and Galati (2023).

Although Brazilian consumers generally have a favorable perception of acquiring products typical of the Amazon biome, which supports local communities, the choice of fresh exotic pirarucu (low-involvement) is limited by its high price and the lack of identification labels in the market. Identification through labels is necessary for the fresh product. Regarding the production process of fresh fish, it is interesting to note that the probability of choice increases with the presence of origin guarantees. In the case of processed products (high-involvement), the probability of choice increases among individuals with higher education but still loses to bovine leather, which is better known.

In this way, the differentiation of pirarucu produced in the Amazon through sustainable practices and certifications is a promising path to attract consumers. These findings align with studies that demonstrate increased willingness to pay when a product adheres to environmental standards (e.g. Rolfe *et al.*, 2023; Signes *et al.*, 2023; Del Giudice *et al.*, 2018). Furthermore, actions that bring consumers closer to the product, such as partnerships with restaurants and promotion of fairs, can contribute to increasing exposure and consumption of pirarucu. It is

important to emphasize that price plays a relevant role, considering that fish prices in the northern region are more accessible. However, it is crucial to take into account that preferences may vary depending on cultural context, local market and individual experiences (Maes, Kohrt, & Closser, 2010; Stancu *et al*., 2022). Therefore, understanding these preferences is essential to develop effective marketing and communication strategies to meet consumer demands and promote more sustainable choices.

This article contributes to the studies that explores only the exotic food product in the original or in the commodity version, like Spina *et al*. (2024), that empirically explores mango, and Chen *et al*. (2023), that analyzes avocado by comparing Pirarucu with their own value-added version (wallet). The contribution is also with the literature of sustainability attributes of quality cues in exotic food product (Tian *et al*., 2022; Isaak & Lentz, 2020).

6. Conclusion

This study explored how sustainability-related quality cues influence consumer behavior and willingness to pay (WTP) for products derived from pirarucu – a fish native to the Amazon biome – distinguishing between its low-involvement (fresh meat) and high-involvement (leather wallet) versions. Grounded in signaling theory and the literature on quality cues, the results confirm that environmental and social attributes play a significant role in shaping consumer choices, although the magnitude of this influence varies with the level of product involvement.

Consumers demonstrated a greater willingness to pay for pirarucu products that signal sustainable practices, particularly when these cues are reinforced by guarantees of origin and social impact certifications. The effect of such signals was especially pronounced in the high-involvement context, where consumers were more likely to process and respond to detailed sustainability information. Nonetheless, in both involvement categories, perceived environmental responsibility positively influenced purchasing intentions and WTP.

These findings reinforce the importance of incorporating effective sustainability signals – such as credible labeling and storytelling – into product communication strategies, especially for exotic or less familiar items. Furthermore, the study highlights opportunities for policy and marketing initiatives aimed at bridging information gaps and enhancing consumer access to sustainably sourced Amazonian products. Future research could further investigate generational and regional differences in sustainability preferences using models that account for individual heterogeneity, such as mixed logit approaches.

By integrating signaling theory with quality cues in the context of sustainable food systems, this study contributes to a deeper understanding of consumer decision-making and offers actionable insights for advancing conservation goals through informed market strategies.

Note

1. For further details on the stepwise methodology, refer to Hastie and Pregibon (2017), available in the R Documentation (package "stats" version 4.1.1, "Choose a model by AIC in a Stepwise Algorithm").

Supplementary material

The supplementary material for this article can be found online.

References

Allen, T., & Prosperi, P. (2016). Modeling sustainable food systems. *Environmental Management*, *57* (5), 956–975. doi: 10.1007/s00267-016-0664-8.

Alvarenga, F. R. P. (2018). Estudo de mercado e da cadeia de valor do couro de pirarucu no Amazonas. *Projeto ARAPAIMA – Operação Amazônia Nativa*, December. Available from: https://www.fundoamazonia.gov.br/pt/.galleries/documentos/acervo-projetos-cartilhas-outros/OPAN-

Arapaima-Estudo-de-mercado-e-da-cadeia-de-valor-do-couro-de-pirarucu-no-Amazonas.pdf (accessed 7 May 2024).

Ateş, H. (2021). Understanding students' and science educators' eco-labeled food purchase behaviors: Extension of theory of planned behavior with self-identity, personal norm, willingness to pay, and eco-label knowledge. *Ecology of Food and Nutrition*, *60*(4), 454–472. doi: 10.1080/03670244.2020.1865339.

Belluzzo Junior, W. (1999). Avaliação contigente para a valoração de projetos de conservação e melhoria dos recursos hídricos. *Pesquisa e Planejamento Economico*, *29*(1), 113–136. Available from: https://ppe.ipea.gov.br/index.php/ppe/article/view/193 (accessed 7 May 2024).

Bimbo, F., Viscecchia, R., De Devitiis, B., Seccia, A., Roma, R., & De Boni, A. (2022). How do Italian consumers value sustainable certifications on fish?—an explorative analysis. *Sustainability*, *14*(6), 3654. doi: 10.3390/su14063654.

Bulsara, H. P., & Trivedi, M. (2023). Exploring the role of availability and willingness to pay premium in influencing smart city customers' purchase intentions for green food products. *Ecology of Food and Nutrition*, *62*(3-4), 107–129. doi: 10.1080/03670244.2023.2200942.

Castello, L., & Stewart, D. J. (2010). Assessing CITES non-detriment findings procedures for Arapaima in Brazil. *Journal of Applied Ichthyology*, *26*(1), 49–56. doi: 10.1111/j.1439-0426.2009.01355.x.

Castello, L., Stewart, D. J., & Arantes, C. C. (2011). Modeling population dynamics and conservation of arapaima in the Amazon. *Reviews in Fish Biology and Fisheries*, *21*(3), 623–640. doi: 10.1007/s11160-010-9197-z.

Chen, Z., Zeng, G., Zhong, S., & Wang, L. (2023). From the exotic to the everyday: The Avocado crossing borders via cyberspace. *Appetite*, *180*, 106362. doi: 10.1016/j.appet.2022.106362.

Del Giudice, T., Stranieri, S., Caracciolo, F., Ricci, E. C., Cembalo, L., Banterle, A., & Cicia, G. (2018). Corporate Social Responsibility certifications influence consumer preferences and seafood market price. *Journal of Cleaner Production*, *178*, 526–533. doi: 10.1016/j.jclepro.2017.12.276.

Freitas, C. T. D. (2019). O que o manejo do pirarucu pode nos ensinar? Aspectos ecológicos, sociais e culturais aplicáveis a múltiplos sistemas socioecológicos, Ph.D. Thesis, Universidade Federal do Rio Grande do Norte, Natal, Brazil. Available from: https://repositorio.ufrn.br/handle/123456789/27589 (accessed 7 May 2024).

Grunert, K. G. (2006). Future and consumer lifestyles with regard to meat consumption. *Meat Science*, *74*(1), 149–160. doi: 10.1016/j.meatsci.2006.04.016.

Grunert, K. G., Will, J. M., & Fernández-Celemín, L. (2010). Nutrition knowledge and use and understanding of nutrition information on food labels among consumers in the UK. *Appetite*, *55*(2), 177–189. doi: 10.1016/j.appet.2010.05.045.

Grunert, K. G., Loose, S. M., Zhou, Y., & Tinggaard, S. (2015). Extrinsic and intrinsic quality cues in Chinese consumers' purchase of pork ribs. *Food Quality and Preference*, *42*, 37–47. doi: 10.1016/j.foodqual.2015.01.001.

Hadker, N., Sharma, S., David, A., & Muraleedharan, T. R. (1997). Willingness-to-pay for Borivli National Park: Evidence from a contingent valuation. *Ecological Economics*, *21*(2), 105–122. doi: 10.1016/S0921-8009(96)00094-8.

Hair, J. F., Black, B., Babin, B., Anderson, R. E., & Tathan, R. L. (2009). *Análise multivariada de dados*. São Paulo, Brazil: Artmed.

Hastie, T. J., & Pregibon, D. (2017). Generalized linear models. In *Statistical models in S* (pp. 195–247). London: Routledge.

Hess, R., Visschers, V., & Siegrist, M. (2012). The role of health-related, motivational and sociodemographic aspects in predicting food label use: A comprehensive study, *Public Health Nutrition*, *15* (3), 407-414. doi: 10.1017/s136898001100156x.

Instituto Brasileiro de Geografia e Estatística – IBGE (2019). Pesquisa de Orçamentos Familiares – POF 2017-2018, Rio de Janeiro. Available from: https://www.ibge.gov.br/estatisticas/sociais/populacao/24786-pesquisa-de-orcamentos-familiares-2.html

Isaak, M., & Lentz, W. (2020). Consumer preferences for sustainability in food and non-food horticulture production. *Sustainability*, *12*(17), 7004. doi: 10.3390/su12177004.

Kajale, D. B., & Becker, T. C. (2014). Effects of information on young consumers' willingness to pay for genetically modified food: Experimental auction analysis. *Ecology of Food and Nutrition*, *53* (3), 292–311. doi: 10.1080/03670244.2013.824433.

Kirmani, A., & Rao, A. R. (2000). No pain, No gain: A critical review of the literature on signaling unobservable product quality. *Journal of Marketing*, *64*(2), 66–79. doi: 10.1509/jmkg.64.2.66.18000.

Lantz, B. (2013). Equidistance of likert-type scales and validation of inferential methods using experiments and simulations. *Electronic Journal of Business Research Methods*, *11*(1), 16–28. Available from: https://academic-publishing.org/index.php/ejbrm/article/view/1299/1262

Lastovicka, J. L., & Gardner, D. M. (1978). Low involvement versus high involvement cognitive structures. *Advances in Consumer Research*, *5*(1), 87–92. doi: 10.1016/j.jclepro.2019.05.012.

Llagostera, P. F., Kallas, Z., Reig, L., & De Gea, D. A. (2019). The use of insect meal as a sustainable feeding alternative in aquaculture: Current situation, Spanish consumers' perceptions and willingness to pay. *Journal of Cleaner Production*, *229*, 10–21. doi: 10.1016/j.jclepro.2019.05.012.

Maes, K. C., Kohrt, B. A., & Closser, S. (2010). Culture, status and context in community health worker pay: pitfalls and opportunities for policy research. A commentary on Glenton et al.(2010). *Social science & medicine*, *71*(8), 1375–1378. doi: 10.1016/j.socscimed.2010.06.020.

Marques, L., & Góes, C. (2019). Apêndice do Relatório de Impacto Socioambiental da Coleção de Moda Osklen 'As Sustainable As Possible'. *Material COPPEAD*. Available from: http://34.98.74.206/wp-content/uploads/2020/04/Ap%C3%AAndice-Relat%C3%B3rio-Osklen-ASAP-2018.pdf (accessed 7 May 2024).

Masi, M., Di Pasquale, J., Vecchio, Y., Pauselli, G., Tribilustova, E., & Adinolfi, F. (2022). A cross-sectional study in Mediterranean European countries to support stakeholders in addressing future market demands: Consumption of farmed fish products. *Aquaculture Reports*, *24*, 101133. doi: 10.1016/j.aqrep.2022.101133.

Melgarejo, P., & Luis, F. (2020). Will the trade of amazonian fruits help recover the Amazon forest? Sustainable consumption of acai in metro vancouver, (Doctoral dissertation, University of British Columbia). Available from: https://open.library.ubc.ca/collections/ubctheses/24/items/1.0394104 (accessed 7 May 2024).

Menozzi, D., Nguyen, T. T., Sogari, G., Taskov, D., Lucas, S., Castro-Rial, J. L. S., & Mora, C. (2020). Consumers' preferences and willingness to pay for fish products with health and environmental labels: Evidence from five European countries. *Nutrients*, *12*(9), 2650. doi: 10.3390/nu12092650.

Nelson, P. (1970). Information and consumer behavior. *Journal of Political Economy*, *78*(2), 311–329. doi: 10.1086/259630.

Olson, J. C., & Jacoby, J. (1972). Cue utilization in the quality perception process. In *Proceedings of the Third Annual Conference of the Association for Consumer Research* (pp. 167–179).

Pedroza-Filho, M. X., Muñoz, A. E. P., Rodrigues, A. P. O., Rezende, F. P., Lima, A. F., & Mataveli, M. (2016). Panorama da cadeia produtiva do pirarucu: o gargalo da reprodução de pirarucu e seus impactos na cadeia produtiva. *Ativos da Aquicultura*, *2*, 1–5. Available from: https://core.ac.uk/download/pdf/78557573.pdf (accessed 7 May 2024).

Petrescu, D. C., Vermeir, I., Burny, P., & Petrescu-Mag, R. M. (2022). Consumer evaluation of food quality and the role of environmental cues. A comprehensive cross-country study. *European Research on Management and Business Economics*, *28*(2), 100178. doi: 10.1016/j.iedeen.2021.100178.

Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. *Advances in Experimental Social Psychology*, *19*, 123–205. doi: 10.1016/s0065-2601(08)60214-2.

Peixe BR (2021). Associação Brasileira da Piscicultura, Anuário 2021: Peixe BR da Piscicultura Pinheiros, SP: Peixe BR. Available from: https://www.peixebr.com.br/anuario-2024/

Pinho, F. G. (2024). Com demanda em alta, indústria do salmão investe no aumento da capacidade para continuar crescendo, Diário do Comércio, Agronegócio, 25 de novembro de 2024. Available from: https://diariodocomercio.com.br/agronegocio/demanda-alta-industria-salmao-investe-aumento-capacidade-continuar-crescendo/

Pino, F. A. (2007). Modelos de decisão binários: uma revisão. *Revista de Economia Agrícola*, *54*(1), 43–57. Available from: http://www.iea.sp.gov.br/out/verTexto.php?codTexto=8993 (accessed 7 May 2024).

Rao, A. R., & Monroe, K. B. (1989). The effect of price, brand name, and store name on buyers' perceptions of product quality: An integrative review. *Journal of Marketing Research*, *26*(3), 351–357. doi: 10.2307/3172907.

Rolfe, J., De Valck, J., Rajapaksa, D., Flint, N., Star, M., & Akbar, D. (2023). Willingness to pay for higher environmental standards for avocado production in Great Barrier Reef catchments. *Food Quality and Preference*, *110*, 104940. doi: 10.1016/j.foodqual.2023.104940.

Santana, E. A., Oliveira, E. F. D., Balbino, N. D. S., & Gurgel, H. (2020). Management of pirarucu (Arapaima gigas, Teleostei, Osteoglossidae) in sustainable use units as a proposal for the restoration of aquatic ecosystems. *Acta Limnologica Brasiliensia*, *32*, e204. doi: 10.1590/S2179-975X2019.

Signes, Á. P., Miret-Pastor, L., Tsiouni, M., Siggia, D., & Galati, A. (2023). Determinants of consumers' response to eco-labelled seafoods: The interaction between altruism, awareness and information demand. *Journal of Cleaner Production*, *433*, 139758. doi: 10.1016/j.jclepro.2023.139758.

Silva, R. G. (2003). Valoração do parque ambiental" Chico Mendes", Rio Branco–AC: Uma aplicação probabilística do método referendum com bidding games. Viçosa: UFV, 2003. 125p (Dissertação - Mestrado em Economia Aplicada) - Universidade Federal de Viçosa). Available from: https://www.locus.ufv.br/bitstream/123456789/9001/1/texto%20completo.pdf (accessed 7 May 2024).

Silva, R. D., Marins, F. R., Melo, L. F., & Silva, A. L. S. (2021). Consumer preferences for sustainable food products: A study using Likert scale. *British Food Journal*, *123*(7), 2280–2293.

Spence, M. (1973). Job market signaling. *Quarterly Journal of Economics*, *87*(3), 355–374. doi: 10.2307/1882010.

Spina, D., Zanchini, R., Hamam, M., Di Vita, G., Chinnici, G., Raimondo, M., … D'Amico, M. (2024). Unveiling the exotic fascination of tropical fruits: The role of food values on consumer behavior towards mangoes. *Journal of Agriculture and Food Research*, *15*, 100956. doi: 10.1016/j.jafr.2023.100956.

Stancu, V., Brunsø, K., Krystallis, A., Guerrero, L., Santa Cruz, E., & Peral, I. (2022). European consumer segments with a high potential for accepting new innovative fish products based on their food-related lifestyle. *Food Quality and Preference*, *99*, 104560. doi: 10.1016/j.foodqual.2022.104560.

Steenkamp, J. B. E. M. (1989). *Product quality: An investigation into the concept and how it is perceived by consumers*, Van Gorcum, Wageningen University Research.

Stock, J. H., & Watson, M. W. (2004). Regressão com uma variável dependente binária. In *Econometria* (pp. 202–218). São Paulo: Addison Wesley.

Tian, C., Luan, W., & Wang, H. (2022). Exotic food, food environment, and geographical patterns: Big data analytics from Japanese cuisine in China. *Frontiers in Earth Science*, *10*, 944927. doi: 10.3389/feart.2022.944927.

Toussaint, M., Cabanelas, P., & González-Alvarado, T. E. (2021). What about the consumer choice? The influence of social sustainability on consumer's purchasing behavior in the food value chain. *European Research on Management and Business Economics*, *27*(1), 100134. doi: 10.1016/j.iedeen.2020.100134.

Ulkhaq, M. M., Rozaq, R., Ramadhani, R., Heldianti, R., Fajri, A., & Akshinta, P. Y. (2018). Validity and reliability assessment of the game addiction scale: An empirical finding from Indonesia. In

Proceedings of the 4th International Conference on Industrial and Business Engineering (pp. 120–124). doi: 10.1145/3288155.3288158.

Underwood, R. L., & Klein, N. M. (2002). Packaging as brand communication: Effects of product pictures on consumer responses to the package and brand. *Journal of Marketing Theory and Practice*, *10*(4), 58–68. doi: 10.1080/10696679.2002.11501926.

Verbeke, W., Vanhonacker, F., Sioen, I., Van Camp, J., & De Henauw, S. (2007). Perceived importance of sustainability and ethics related to fish: A consumer behavior perspective. *Ambio*, *36*(7), 580–585. doi: 10.1579/0044-7447(2007)36[580:PIOSAE]2.0.CO;2.

Yang, Y., Hobbs, J. E., & Natcher, D. C. (2020). Assessing consumer willingness to pay for Arctic food products. *Food Policy*, *92*, 101846. doi: 10.1016/j.foodpol.2020.101846.

Corresponding author
Eduardo Eugênio Spers can be contacted at: edespers@usp.br

Associate editor: Fabio Sandes