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Restaurateurs' context, decisions, and views on supporting sustainable seafood: Insights from Chile

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While restauranteurs are important actors in seafood systems, information on their decisions and views on sustainability is lacking. Using mixed methods, we explored Chilean restauranters' contexts, decisions, and views on seafood sustainability. Menus in Chile are diverse and dominated by domestic and wild-caught sources. Restauranters are willing to participate in traceability programs, especially when it is for both sustainability and health safety reasons. Restauranters believe that seafood is an elite resource and high prices are inhibiting access. They also believe patrons care little about seafood sustainability yet are willing to pay a premium for it. This contradiction suggests a mechanism for activating values *via* situational factors. While demand and benefits for seafood traceability programs appear present, challenges threaten successful implementation. Complex socio-economic factors, such as affordability, elitism, and inequity, need to be integrated into traceability program design to contribute to the necessary transformation of seafood systems.

KEYWORDS

chefs, choice experiment, restaurants, seafood, sustainability, traceability

Introduction

The production of seafood, captured from or cultivated in the ocean, will need to expand in the coming decades to meet population- and income-driven demand (Costello et al., 2020). Accordingly, there has been recent focus on exploring seafood from a wider food systems perspective (Guillen et al., 2019). However, visions of what constitutes progress towards a sustainable food system diverge (Short et al., 2021). A key underexplored actor, critical in seafood systems, are restaurateurs and chefs. Both are opinion leaders, who can disproportionally influence food systems and the general public (Inwood et al., 2009; Seaman et al., 2022). One notable example is the 1998 Give Swordfish a Break campaign that targeted chefs, urging them to temporarily stop serving swordfish. Over 700 chefs boycotted swordfish, which influenced several policy and management changes that purportedly contributed to population recovery (Brownstein et al., 2003). Peru provides another example, where celebrity chefs hold huge influence. A 2014 poll of likely voters revealed that 23% would have voted for Gastón Acurio for president—perhaps the country's most celebrated chef and known for promoting food sustainability and security (Anonymous, 2014). Because a large percentage of seafood is consumed in restaurants, chefs and restaurateurs (hereafter, collectively referred to as restaurateurs) can play a major role in influencing what seafood products the public consumes. In 2017, for example, US consumers spent ~$70 billion on seafood at food service establishments compared to ~$32 billion at home (National Marine Fisheries Service, 2017). Yet unlike consumers (Carlucci et al., 2015; Fonner and Sylvia, 2015; Hilger et al., 2019), there has been little research on the decisions and views of restaurateurs with respect to seafood sustainability (Moreau and Speight, 2019; but see De la Lama et al., 2018).

Restaurateurs can influence seafood consumption in two direct ways. First, of course, is by what seafood products they choose to include on their menus. Seafood consumption is often dominated by a few select species. In the United States, for example, just five species have made up >60% of total consumption over the past twenty years (Shamshak et al., 2019). Some advocate eating more seafood species that are underutilized or from lower trophic levels as an avenue to improve overall sustainability by lowering fishing pressure on overexploited stocks (Farmery et al., 2020; Scherer and Holm, 2020). Second, is the characteristics of how seafood products on the menu are sourced. This includes aspects such as who, where, and how seafood products are harvested, as well as associated certification and traceability programs. Seafood certification programs, such at the Marine Stewardship Council, have been around for decades. Alternative models are also emerging that seek to better fit the unique characteristics of certain fisheries (Koldewey et al., 2009; Stoll et al., 2020), including programs that focus on tracing seafood from the boat to the end consumer. Traceability is a tool that allows the confirmation of any number of sustainability aspects (e.g., ecological, local, or fair trade) (McClenachan et al., 2016; El Sheikha et al., 2018). It has gone from playing a minor and inconspicuous role in the seafood industry to being at the center of the sustainable seafood movement. In many countries, government traceability policies are being implemented, while non-profit organizations and for-profit ventures focused on seafood traceability are increasingly common (Burwood-Taylor, 2016; Hofherr et al., 2016; Lewis and Boyle, 2017).

While once used almost exclusively within business-to-business systems to manage risk (e.g., food safety), consumer-facing seafood traceability systems are being promoted to address a range of concerns (Sterling et al., 2015; Lewis and Boyle, 2017; El Sheikha et al., 2018). While some advocate traceability for all seafood (Oceana, 2020), implementing traceability can be costly and often requires extensive coordination within complex and informal supply chains. There are also concerns regarding the burden of information disclosure, potential inequities (Bailey et al., 2016), and technical challenges (El Sheikha and Xu, 2017). Since restauranters are influential on food systems, their knowledge could be useful in designing traceability programs that are desirable and address important concerns at the local, regional, and national scales. Yet, contrary to the technological and supply-side aspects of traceability programs, there is less information available about restauranters' decisions and views around seafood traceability (Leal et al., 2015; Sterling et al., 2015; Tamm et al., 2016). To help fill this important knowledge gap, we studied three research questions:

- Which attributes of traceability programs are most relevant to restauranteurs' willingness to participate?
- What are restauranteurs' perceptions of their clients and the costs associated with seafood consumption?
- How might context, determined by menu characteristics, influence restauranteurs' decisions and views?

The main goal of this study is to provide insights on the potential of seafood restauranters to influence food systems and promote sustainability, as well as the challenges they face to do so. Using Chile as a case study, we explore seafood restauranters' context, decisions, and views on various aspects of sustainability. An important fishing nation, Chile is among the top ten countries for both marine capture and aquaculture seafood production (FAO, 2018). While per capita apparent seafood consumption in Chile (13 kg) is lower compared to some countries (e.g., 23 kg in Peru), it represents the average consumption throughout Latin America (12 kg). In the Americas, many countries have nascent and emerging markets for high-quality and sustainable seafood (Guy, 2018; National Marine Fisheries Service, 2018; Michail, 2019). We assess what seafood restaurateurs are selling and then explore how those menu items might influence their 1) purchasing decisions around various attributes of sustainable seafood and 2) perceptions on their clients and the cost of seafood (Figure 1). First, we conduct a menu analysis of seafood restaurants in Chile, focusing on the capital Santiago where ~8 million of its nearly 19 million people reside, as well as the nearby port of Valparaiso. Second, we conduct a stated choice experiment on seafood traceability programs. Since traceability does not occur in a vacuum, we assess restaurateurs' decisions for seafood quality, price, and reliability, as well as different traceability programs. Third, we explore restauranters' perceptions on their clients' motivations for eating seafood, as well as the cost of doing so in Chile.

Methods

Sampling

Our sample frame included all restaurants that served predominately seafood in Santiago, as well as restaurants in the Valparaiso region, 115 km from Santiago and located on the coast of central Chile. We conducted face-to-face structured surveys targeting restauranters, which we define as a person that has decision-making responsibility for purchasing seafood in a restaurant. In a small number of cases, interviewees had knowledge of decision-making, but were not responsible for taking decisions (see results). We sampled restaurants by compiling a database using available restaurant online platforms (i.e., Zomato, Foursquare, and TripAdvisor) using the keywords (in Spanish) seafood, restaurant, Santiago, Valparaiso, and Viña del Mar. Using restaurant web pages or in-person visits, we included restaurants in our sampling frame if they had at least ten seafood products on their menu. Restaurants were then mapped and at least one restaurant for each municipality was selected. We then randomly selected 160 restaurants from the sample frame. During the interviews, we asked restaurateurs to recommend one restaurant they thought would be important to include. If the restaurant was not part of the initial 160 restaurants, it was added to the sample. This procedure was repeated until a total of 200 seafood restaurants were sampled.

Our survey consisted of three sections. First, we asked several contextual questions about the role(s) of the restauranter and the general characteristics of the restaurant. Second, we used a stated choice approach to assess restauranteurs' decisions for a voluntary seafood traceability program. Each interviewee was presented with four choice sets that each had two programs. S/he was asked to indicate their preferred program or opt-out of program participation altogether. The hypothetical programs purposely did not include a specific seafood product; rather, it was described as a general seafood program. Third, we asked restauranters questions focused on their perceptions of the cost of seafood in Chile, as well as the reasons they believed their clients eat seafood. All methods were performed in accordance with the

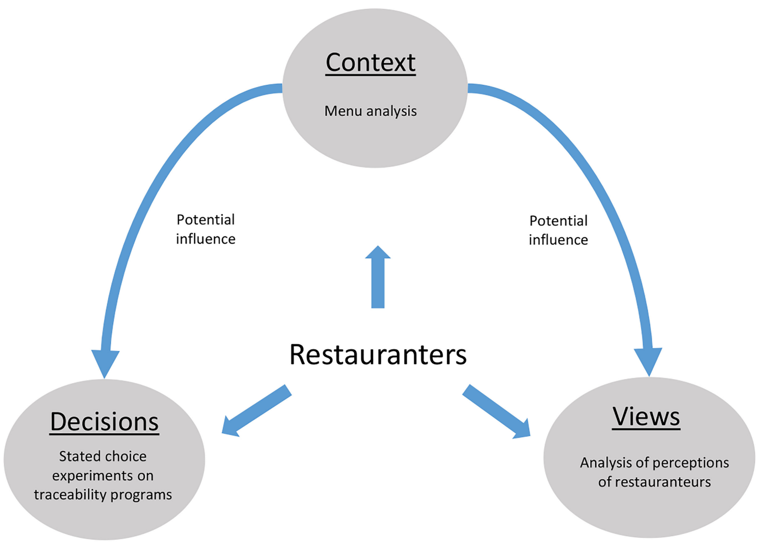

FIGURE 1
Exploring the context, decisions, and views of Chilean restauranters on seafood sustainability. Using a mixed methods approach, we use a menu analysis, stated-choice experiment, and perception survey to provide insights on different factors that influence restaurateurs' ability to promote sustainable seafood. We also explore how local context (e.g., what seafood is being served) might influence restauranters' decision-making and views about sustainability.

relevant guidelines and regulations, and this study was approved by the Pontificia Universidad Católica de Chile and Virginia Tech institutional review boards. All common names and taxonomy follow Fishbase and Sealifebase (Froese and Pauly, 2020; Palomares and Pauly, 2020).

Menu analysis

We analyzed the menus of each restaurant where interviews were conducted. We collected price data on two common menus items: *camaron* (shrimp) and *reineta* (*Brama australis*, southern rays bream). We calculated several summary statistics that characterize Chilean seafood restaurants and provide insights to the seafood being consumed, including:

- Number (and percentage) of menu items that are seafood (i.e., marine fish and invertebrates),
- Marine species that have the most items on the menu (e.g., four different types of shrimp dishes), and
- Total number of marine species (i.e., species richness).

Program attributes

The voluntary traceability program was described to restaurateurs as in the scoping phase for interest and viability within the seafood restaurant sector. Because actual behavior of restauranters cannot be observed *a priori*, we asked them to indicate their approval of program prototypes, which consisted of four program design attributes (Table 1). The first attribute was wholesale market price, which consisted of four levels: the price the restaurateur is currently paying and three levels of an increase in ten percentage points. The cost of a traceability program will vary depending on the details, as well as who along the supply chain absorbs the financial burden (e.g., distributors) (Mai et al., 2010). However, the wholesale price is unlikely to decrease with the inclusion of a traceability program and it is reasonable to hypothesize than it could increase. The second attribute was reliability in supply, which had four levels that were expressed as the probability that the seafood was available every week (Table 1). The third attribute was quality of the seafood with two levels: what the interviewee usually receives and a higher quality, on average, than is usually received (i.e., premium). The fourth attribute was the presence and purpose of traceability, which had four levels including no traceability mechanism in place. One level was that seafood was tracked to ensure the health and safety of the seafood, while another level was that the purpose of the traceability was to improve the sustainability of the resource. The final level included both purposes.

It was both impractical and statistically inefficient to include all possible combinations of attributes in Table 1 for evaluation.

TABLE 1 Voluntary seafood program for restaurants with four attributes and levels evaluated.

Program Characteristic	Levels
Wholesale market price	Current Price
	10% higher
	20%
	30%
Reliability of supply	65% chance it is available every week
	75%
	85%
	95%
Quality	Normal
	Premium
Purpose of traceability	No traceability
	Health and safety
	Sustainable management of seafood populations
	Health and safety and sustainable management

Thus, we used a fractional factorial design to select a subset of 60 program comparisons (Louviere et al., 2000). We then blocked the comparisons into 15 versions of the survey and randomly assigned a survey version to each respondent. Within the survey, each restauranter responded to four program comparisons.

Analysis of program participation

We employed a program desirability lens to examine scenarios of the most and least desired programs as determined by responses to the stated choice survey (Sorice et al., 2018). We modeled program participation as a function of the program attributes and their levels. Our model assumes that restauranters are willing to participate in a program if the utility of participating is greater than not participating. Further, restauranters will approve a program in which their overall preference for a program structure exceeds an alternative structure. That is, restauranters prefer program i over j when Ui > Uj. The utility function is unobservable and instead we model the probability of choosing program i over j using a conditional logit formulation (Ben-Akiva and Lerman, 2018):

$$P(i|i \in M) = \frac{e^{V_i}}{\sum_{j=M} e^{V_j}}$$

Where M is all the choice sets contained in the study, Vi, and Vj are the observable utilities for each set of programs. Marginal effects were calculated at representative values of covariates using Stata (version 16), and we report them as the predicted probability that a restauranteur would participate in a seafood program (Williams, 2012).

To control for any variation in responses due to the cost of dining or the diversity of seafood products available at a restaurant, we included three indices into the stated choice model that were derived from the menu analysis (see above). First, we used a principal components analysis to create a composite variable reflecting the combined menu price of *reineta* and *camaron*, which were strongly correlated. The composite index is useful because the two seafood products are among the most commonly served in Chilean restaurants and prices vary across restaurants (see Results). We computed the composite score (mean = 0, sd = 1) for each respondent. Second, we included two indices in the model that reflect the diversity of seafood at a restaurant: total number of seafood dishes and total number of seafood species on the menu.

Analysis of perceptions

We evaluated restauranters' perceptions on two aspects: 1) their clients' motivations for eating seafood and 2) the cost of seafood. For both aspects, we asked seven questions (see Figure 2). All survey questions were answered on a 5-point Likert scale. We used an ordinal mixed-effects models to explore factors that might explain restauranteurs' differences in their perceptions on the two aspects. Of the total number of questions asked in both client and cost aspects (n = 14), we selected only those questions that were heterogeneous in their responses (i.e., *agree* and *strongly agree* where<50%), which were used as response variables (n = 6). We used two fixed effect predictors in the models, after checking for collinearity: 1) percentage of menu items that were seafood as a proxy for the level of importance of seafood for a restaurant and 2) the menu price of *reineta* dishes as a proxy for the purchasing power of a restaurant's clientele. *Reineta* prices were used as this was a common menu item for which we collected price data (n = 157 restaurants). To control for location, we used the municipality where the restaurant was located as a random effect. We included restauranters from municipalities where at least five restaurants were surveyed. We used the ordinal package in the R statistical language (Christensen, 2015). For all analyses, we adopted an alpha level of 0.05.

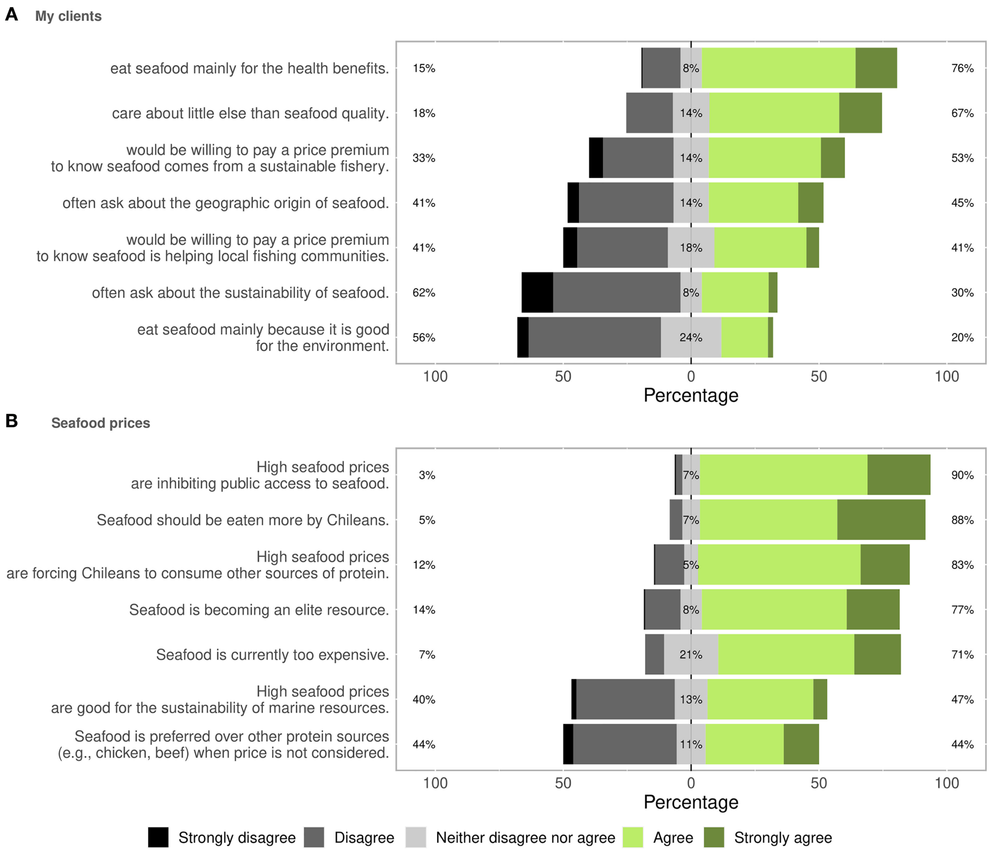

FIGURE 2
Chilean restauranters' perceptions on **(A)** their clients and **(B)** the cost of seafood. All survey questions were answered on 5-point Likert scale. The percentages on the left and right represent the sum of strongly disagree + disagree and strongly agree + agree, respectively.

Results

Sampling

We conducted 203 interviews with restaurateurs from 200 seafood restaurants. Of those, we analyzed 196 menus, 89% of which were in Santiago (Table 2). Our sample covered a diversity of restaurateurs, restaurant types, and cost of dining. Respondents were asked what roles they played in the restaurant; they could choose more than one option and write in a role if it was not present. A management role was identified the most often (61%), followed by the head (or executive) chef (17%), owner (12%), seafood buyer (7%), and a variety of service roles (10%, e.g., waiter, host). Our sample was diverse with respect to cost of dining. One third (30%) reported an average cost per person between USD$ ~7-12 (CLP 6,000-10,000), approximately a third (33%) reported ~$13-18 (CLP 11,000-15,000), and approximately a third (31%) reported >$19 (>CLP 16,000). The remainder (6%) reported the per person cost average was<$6 (<CLP 5,000; USD to CLP exchange rate: 1:713). Seating capacity of restaurants where interviews were conducted varied between 15-560, with a mean of 133 (± 14, 95% CI). The median seating capacity was 100. Over half of the respondents (56%) had some knowledge of seafood traceability. Approximately a third (33%) of the restaurants already had been certified under the Chilean government *Sello Azul* program (see Discussion).

Menu analysis

We analyzed 196 menus from the 200 restaurants where surveys were conducted (98%; Table 2). On average, the menus sampled contained 11 marine species (95% CI = 0.79) and seafood made up 66% of the menu items from the restaurants sampled (95% CI = 3%). Menus included slightly more invertebrate species than fish species (invertebrate mean = 6.8, 95% CI = 0.5; fish mean = 4.6, 95% CI = 0.03). While we recorded a total of 62 seafood products across all the menus, thirteen were present on 40% or more of the menus (Table 3). Thirty-four products were present on ≤5% of the menus. *Reineta* was the most abundant fish: it was present on 87% of the menus and had the greatest number of dishes on 53% of the menus (mean = 13.4 dishes). This was followed by Atlantic salmon (*Salmo salmo*) and *congrio* (*Genypterus* spp.), which had the greatest number of dishes on 24% (mean = 5.3 dishes) and 7% (mean = 7.2 dishes) of the menus, respectively. *Camaron* (i.e., shrimp) was the most abundant invertebrate: it was present on 100% of the menus and had the greatest number of dishes on 94% of the menus (mean = 13.8 dishes). This was followed by octopus (*Octopus mimus* or *Enteroctopus megalocyathus*) and clams (*Ameghinomya antiqua*), which had the greatest number of dishes on 2% (mean = 6.0 dishes) and 1% (mean = 2.75 dishes) of the menus, respectively.

Program attributes

Overall, restauranters preferred to participate in programs over no program (b = -2.7, Z = -3.88, p< 0.001), regardless of the cost of dining at the respective restaurant (Table 4). All attributes were related to program selection and the probability of opting into a program was high for some programs. As wholesale price increased, preference for a program decreased ($Wald\ X^2_{(3)}$ = 26.96, p< 0.001). Increased reliability in the supply of seafood was related to an increase preference for a program (Table 4). Overall, premium quality was preferred over current quality. Traceability was preferred over no traceability, and a combination of sustainability and health and safety was the most preferred type of traceability ($Wald\ X^2_{(3)}$ = 27.00, p< 0.001).

Restauranters were much more likely to opt into a program if it had a traceability component. The probability of a restauranter opting into a program that lacked traceability was less than 50%, even for the most desirable program (Figure 3). Traceability for sustainable management increased that probability up to 92% for the most desirable program (i.e., current price, premium quality, and highest reliability). When traceability addressed both seafood and health and safety, the probability of opting in was the highest (75- 96%; Figure 3). Even with a program that had a 30% price increase, regular quality, and low reliability, the probability of opting into a health and sustainability traceability program was 75%.

Analysis of perceptions

Restauranters believed their clients care more about seafood quality and its health benefits, and care less about the sustainability of seafood and its connection to a healthy marine environment (Figure 2A). Yet, around half (53%) of restauranters *agreed or strongly agreed* that their clients would be willing to pay a price premium for traced sustainable seafood. Less than half (41%) *agreed or strongly agreed* that their clients would be willing to pay a price premium for seafood that was helping local communities (Figure 2A). The cost of dining, represented by the price of *reineta*, did not have an impact on the four relationships (p>0.12; Table S1). In restaurants where there was more seafood on the menu, restauranters agreed more with the following three statements:

1. Clients often ask about the geographical origin of seafood (β=52, p<0.01),
2. Clients often ask about the sustainability of seafood (β=3.46, p<0.01), and

TABLE 2 Contextual characteristics of restaurants where interviews were conducted.

Area	# Restaurants	% Menu items seafood	# Unique seafood products	$*Camaron*	$*Reineta*
Vitacura	23	66%	13	14.50	13.95
Las Condes	15	50%	8	13.88	12.41
Macul	2	82%	16	12.46	10.50
La Reina	6	50%	9	12.46	11.62
Viña del Mar*	13	60%	10	12.09	12.12
La Florida	7	60%	10	12.08	10.63
Recoleta	1	62%	10	12.04	11.48
Providencia	44	66%	10	11.82	11.85
Santiago	14	60%	10	11.66	12.12
Puente Alto	1	73%	7	10.85	9.66
Ñuñoa	19	73%	9	10.55	10.88
Caleta Portales*	2	83%	18	10.50	12.88
Santiago Centro	40	71%	13	9.93	11.52
Valparaíso*	9	85%	13	9.85	12.34
Total (mean)	**196**	**(66%)**	**(11)**	**(11.56)**	**(11.96)**

All areas apart from three (*) were in the Santiago metropolitan area. On average, menus consisted of 66% seafood items with 11 marine species, and the average cost for *camaron* (shrimp) and *reineta* (*Brama australis*) was ~USD$12.

3. Clients often eat seafood mainly because it is good for the environment ((β=42, p<0.01).

Restauranters had largely consistent beliefs about the cost of seafood. Ninety percent and 71% *agreed or strongly agreed* that high prices where inhibiting access to seafood and that seafood is too expensive, respectively (Figure 2B). Over three quarters *agreed or strongly agreed* that seafood is becoming an elite resource in Chile and high prices are forcing Chileans to consume other protein sources. Yet, 88% of restauranters

TABLE 3 The thirteen most common seafood products that were present on restaurant menus in Chile.

Menu Item (Common Name)	Scientific Name	# SPP	Frequency	P	Domestic	Imports
Camaron (shrimp)	*Heterocarpus reedi, Litopenaeus vannamei, Penaeus monodon*	3	100%	WC/A	4,986	8,993
Salmon (Atlantic salmon)	*Salmo salar*	1	94%	A	699,237	1,036
Reineta (southern rays bream)	*Brama australis*	1	87%	WC	28,174	0
Pulpo (Changos octopus, Patagonian giant octopus)	*Octopus mimus, Enteroctopus megalocyathus*	2	77%	WC	2,780	32
Calamar (jumbo flying squid)	*Dosidicus gigas*	1	69%	WC	144,646	47
Ostion (Peruvian calico scallop, vitreous scallop)	*Argopecten purpuratus, Delectopecten vitreus*	2	61%	A/WC	15,748	148
Choro (choro mussel)	*Choromytilus chorus*	1	56%	A	3,340	333
Jaiba (crab)	Infraorder: Brachyura	10	56%	WC	9,301	134
Atun (tuna)	*Thunnus* spp., *Gasterochisma melampus*	4	49%	WC	31	31,524
Macha (macha clam)	*Mesodesma donacium*	1	49%	WC	2,366	27
Congrio (cusk-eel)	*Genypterus blacodes, G. chilensis, G. maculatus*	3	47%	WC	1,938	0
Merluza (hake)	*Merluccius gayi, M. australis,* *Macruronus magellanicus* *Micromesistius australis*	5	44%	WC	63,553	1,353
Almeja (cancellated clam)	*Ameghinomya antiqua*	1	40%	WC	12,114	27

The number of species represented by the product ranged from 1-10. Production method (P) is dominated by wild-caught fisheries (WC) compared to aquaculture (A). Except for shrimp and tuna, most products come from domestic sources. Domestic production and imports are from SERNAPESCA and FAO (2018, metric tons).

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TABLE 4 Parameter estimates (mean and standard error) of the random parameter logit model.

Attribute	B	SE	Z	P	95% CI Lower	95% CI Upper
Alternative Specific Constant	-2.72	0.70	-3.88	<0.001	-4.09	-1.34
Wholesale Price						
Usual price		*(reference category)*				
10% higher	-0.32	0.21	-1.52	0.12	-0.73	0.09
20% higher	-0.77	0.20	-3.83	<0.001	-1.17	-0.38
30% higher	-0.91	0.20	-4.43	<0.001	-1.31	-0.51
***Reliability**	2.04	0.65	3.15	0.002	0.77	3.30
Quality						
Usual		*(reference category)*				
Premium	0.70	0.13	5.55	<0.001	0.45	0.95
Traceability						
None		*(reference category)*				
Health and safety	2.54	0.28	8.96	<0.001	1.98	3.09
Sustainable management	2.36	0.29	8.16	<0.001	1.79	2.92
Health, safety, and sustainable management	3.38	0.30	11.28	<0.001	2.79	3.97
Cost of Dining	0.06	0.11	0.61	0.54	-0.14	0.27
Number of Seafood Dishes	-0.002	0.006	-0.31	0.75	-0.01	0.01
Number of Seafood Species	0.01	0.03	0.42	0.68	-0.04	0.06

*There are no levels in the reliability attribute as it was treated as a continuous variable in the model because it was made up of equally spaced real numbers (i.e., 65%, 75%, 85%, and 95%). The mean (B) represents a measure of satisfaction (or marginal utility) that can be ascribed to a specific program attribute (i.e., the more positive, the more the program attribute is preferred). Three control variables were included in the model to control for cost of dining and the diversity of seafood products available at a restaurant. Log likelihood: -391.5514; $X^2_{(12)}$ = 403.40, p< 0.001; Pseudo R^2 = 0.34.

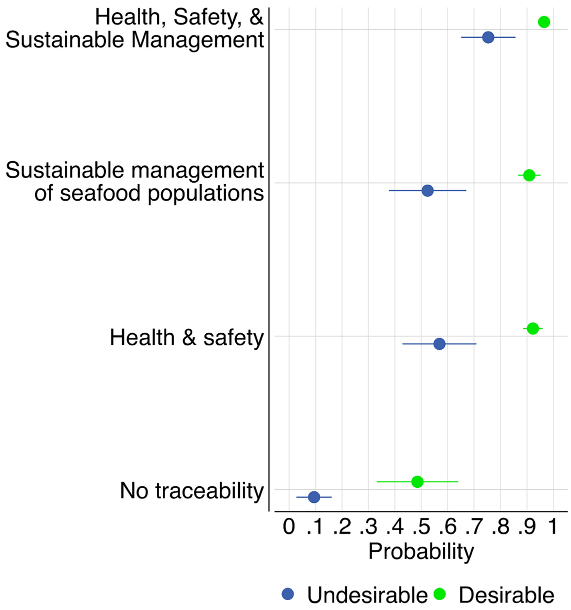

FIGURE 3
Predicted probability (and 95% confidence intervals) of restaurateur participation in voluntary traceability programs. The most undesirable program was one with a 30% increase in price, 65% reliability, and usual quality. The most desirable program was one with the current price, 95% reliability, and premium quality. Three control variables were included in the model to control for cost of dining and the diversity of seafood products available at a restaurant (see Table 4).

believed that Chileans should eat more seafood (Figure 2B). Neither the amount of seafood on the menu nor cost of dining had a significant relationship with the responses to questions about seafood prices (Table S1).

Discussion

Given that seafood is often consumed outside of the home, restauranteurs have the potential to influence seafood systems (Inwood et al., 2009; Seaman et al., 2022). Advocates are increasingly trying to enlist restauranteurs in helping to promote seafood sustainability, and many programs exist that provide resources to support their decision-making (De la Lama et al., 2018; Moreau and Speight, 2019). Today, restauranters are increasingly aware of the sustainability challenges surrounding seafood. Yet, little is known about the restauranters' context, decisions, and views around sustainability, and even less about the constraints they face. In Peru, for example, most chefs appear to be aware of the many unsustainable seafood practices and believe restaurants should play a role in improving them (De la Lama et al., 2018). However, they are forced to operate within a system of poor fisheries regulations and they are risk averse with respect to drastic changes due to the low profit margins under which they operate (De la Lama et al., 2018). Similarly, our results provide insights into the preferences and motivations that restauranteurs have for seafood sustainability as well as the many challenges of implementing sustainability improvements in seafood restaurants—the context where such improvements may be desirable yet often inhibited by constraints and conflicting goals.

Chilean restauranters appear willing to participate in voluntary seafood traceability programs. Perhaps surprisingly, cost of dining did not influence the willingness to participate. The probability of participating was highest when the purpose for traceability was for both sustainability and health safety reasons. Quality, price, and reliability also played important roles in participation; these characteristics are known to be important to seafood restauranters (Fabinyi and Liu, 2014; Geslani et al., 2015; Lawley and Howieson, 2015). However, even when the wholesale price increased by 30% and reliability was relatively low, the probability of restauranters opting into a program with sustainability and health traceability was over 70% (Figure 3). Further, over half of restauranters believed their clients would be willing to pay a premium to know the seafood they order comes from a sustainable fishery. Together, this suggest there may be sufficient demand for restaurant seafood traceability programs in Chile.

Our results, however, identified challenges to implementing traceability programs in Chilean restaurants. Restauranters believed that seafood was already too expensive, is becoming an elite resource, and high prices are inhibiting its access. These are views that are often ignored in efforts to promote seafood sustainability in restaurants. Restauranters' believed their clients eat seafood largely for health benefits and do not enquire much about sustainability, but they also believed their clients are willing to pay a premium for it. While this may seem contradictory, it also suggests a potential mechanism that makes campaigns like *Give Swordfish a Break* successful beyond the draw of charismatic opinion leaders. Situational factors mediate the relationship between holding particular values and acting on those values (Vallacher and Wegner, 1987). The perception of low concern by restaurateurs may reflect that the value of sustainable seafood lacks salience for patrons, especially in combination with the context of selecting a restaurant (e.g., location, price, ambiance, etc.). Yet, the presence of sustainably sourced seafood on the menu may serve to activate a combination of values that result in a willingness to pay a premium for it (Torelli and Kaikati, 2009). This prompt could appeal to restaurant patrons who have engaged in little conscious reflection on their values toward seafood sustainability yet consider it congruent with personal values directly related to environmental protection (e.g., care) or more broadly related to the situation (e.g., honesty, transparency, pride) (Maio and Olson, 1998). We found a positive relationship between the amount of seafood species on the menu and restauranters' beliefs that their clients care about the geographical origin and sustainability of seafood. This suggests that restaurants that serve more seafood might be patronized by consumers that have a greater interest in where and how seafood is caught. Yet, the cost of dining did not have an influence on restauranters' view that their clients would be willing to pay a price premium for traced sustainable seafood. This suggests that there may be potential for traceability programs across the different types of seafood restaurants in Chile. Further research is necessary to explore ways that restaurateurs can act as leverage points for change in seafood systems.

The potential benefits of any seafood traceability program in restaurants are necessarily limited to the species being served on the menu. Contrary to many countries (Swartz et al., 2010; Gephart et al., 2019; Shamshak et al., 2019), most seafood served in Chilean restaurants comes from domestic sources. Of the thirteen seafood products that appear in 60% of the menus sampled, only tuna and two species of shrimp are imported in significant volumes. Over 90% of the remaining eleven products come from domestic sources (Table 3). With a few important exceptions (i.e., salmon, shrimp, mussels), most of the commonly consumed seafood in restaurants comes from wild-caught fisheries, such as *reineta*, octopus, jumbo flying squid, cusk-eel, and hake (Table 3). Thus, in general, there appears to be opportunities for a voluntary traceability program to support sustainability improvements for domestic wild-caught and farmed seafood. While several fisheries are Marine Stewardship Council certified in Chile, the majority of the product is currently exported (MSC, 2022). The government

Sello Azul program is a first basic step toward supporting seafood sustainability. About a third of the respondents were already part of the national program, which certifies seafood vendors that meet basic standards with respect to fishing regulations, legality, health, and sanitary conditions (SERNAPESCA, 2022). A voluntary traceability program could be designed so that it was integrated with the Sello Azul program, while incentivizing additional sustainability improvements (Torres Cañete et al., 2022).

Conclusions and future perspectives

While Chile is a major seafood exporter (FAO, 2022), new markets focused on more sustainable seafood have been emerging domestically over the past decade. While these markets are small, they are expected to grow as national demand for sustainable seafood increases (Núñez, 2020; Campos-Requena et al., 2022). Despite investments for Chilean fisheries reform, these emerging markets face several major challenges. First, a high percentage of fisheries landings in Chile come from the small-scale sector, which often lack access to existing certification programs (e.g., Marine Stewardship Council). Many of the common seafood on menus in Chile are harvested exclusively by small-scale fisheries (e.g., octopus and crab). Second, Chilean fisheries suffer from high levels of illegal activity, including products that are consumed domestically (e.g., hake and loco; Oyanedel et al., 2018; Oyanedel et al., 2020; Donlan et al., 2020). Last, a certain degree of informality within the domestic supply chain can support undesirable practices, such as the procurement of illegal seafood and mislabeling (Haye et al., 2012; Dufflocq et al., 2022). Thus, challenges exist on both the supply and demand side with respect to improving the sustainability of the domestic seafood market. Since restauranters are often in the position to be early adopters in new innovative programs, understanding their preferences and constraints with respect to purchasing more sustainable seafood is important for the design of successful programs and can complement efforts *on the water* to improve fisheries in Chile.

Increasing evidence points to the potential for sustainable fisheries to contribute to food security and livelihoods while maintaining fish stocks and biodiversity (Diz et al., 2019; Cochrane, 2021). Traceability programs are one tool that can encourage and incentivize seafood sustainability (Lewis and Boyle, 2017; El Sheikha et al., 2018). The successful design of such programs involves multiple factors, which include granularity, technology, fisher adoption, standards, and supply chain integration (Thompson et al., 2005; Karlsen et al., 2012). However, the success of these programs also relies on the consideration of the local contexts and the views of the end users. This is especially true for voluntary programs. These local factors have received less attention in terms of design attributes compared to other factors. While restauranters play an influential role in seafood systems, they have largely been ignored with respect to the design of seafood traceability programs. Our results provide a first characterization of restauranters' views and challenges surrounding the potential implementation of seafood traceability programs in Chile, an important fishing nation and where consumption is dominated by domestic sources. While willingness, demand, and latent benefits for restaurant seafood traceability programs appear present in Chile, restauranters face significant challenges in implementing successful programs. Traceability does not occur in a vacuum (Bailey et al., 2016). In addition to biological factors (e.g., sustainable supply, measurable improvements), complex socio-economic factors, such as affordable, elitism, and equity, need to be addressed and integrated into the design of traceability programs. Not doing so may be discouraging the widespread adoption of seafood traceability and reinforcing inequality instead of contributing to the necessary transformation of seafood systems.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Pontificia Universidad Católica de Chile Virginia Tech. The patients/participants provided their written informed consent to participate in this study.

Author contributions

SG, CD, and MS conceived the research; SG, CD, and MS designed the survey and analyses; FC-D collected the data; MS, FC-D, CD, RO, MÁ-T conducted the analyses and created the figures; CD, SG, MS, MÁ -T, and RO wrote the paper. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2022.1009130/full#supplementary-material

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