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Consumer preference for eco-labelled aquaculture products in Vietnam

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ABSTRACT

Product labelling with eco-certifications is market-based incentive tool for sustainable aquaculture, thus mitigating negative environmental impacts. The aims of this study are to investigate: i) whether consumers prefer eco-labelled (eco-certified) shrimps over conventional (non-certified) shrimp; and ii) whether consumers prefer specific eco-label (eco-certification logo) over others. The study used a discrete choice experiment method and the structured interviews with 353 consumers in Khanh Hoa province and Ho Chi Minh city, Vietnam. The results show that a majority of consumers prefer shrimp product. They place higher value on eco-labelled shrimps compared to conventional shrimp. Despite the heterogeneity in preference for eco-labelled shrimp products, highest premium is recorded for farmed shrimp labelled with ASC logo – a third-party certification. Meanwhile, the shrimp labelled with VietG.A.P logo, Vietnamese government certification, has lowest premium. Consumers, who believe that the contribution of individual actions is significant for better aquaculture practices, are willing to pay more for eco-labbelled shrimps. The findings provide scientific evidences on how consumer participation is supporting the transition to sustainable aquaculture in Vietnam. Policy implications for policymakers in terms of sustainable aquaculture development in Vietnam and for marketers designing the effective marketing strategies in the retail food sector are also discussed.

1. Introduction

Aquaculture is the fasted growing food sector worldwide (Bray, 2018). However it is controversial because of its environmental impacts, such as water pollution, disease outbreaks, mangrove destruction, and natural resource degradation (Edwards, 2015). This raises questions for the contribution of aquaculture to sustainable development (Bergleiter and Meisch, 2015; Hughner et al., 2007), consumers' awareness and demands towards sustainable aquaculture products (Hinkes and Schulze-Ehlers, 2018; Janssen and Hamm, 2012; Zander et al., 2018), and development of eco-certification programs (Bergleiter and Meisch, 2015; Bray, 2018). Voluntary third-party certification for seafood products, which was developed since 1990s, has been considered as a market-based tool for minimizing potential negative impacts and increasing societal and consumer benefits (Bray, 2018; FAO, 2018a). Consumers often relate seafood certifications with product quality and sustainability, hence they are willing to pay a premium for sustainable seafood, thereby promoting sustainable aquaculture (Brécard et al., 2009; Carlucci and Devitiis, 2017; Jonell et al., 2016; Kim and Lee, 2018; Pérez-ramírez et al., 2015; Yi, 2019). Despite the number of efforts to establish markets for certified aquaculture products, the share of these products in the world market has remained small. It accounted for 6% of global aquaculture supply in 2015 and dominated in developed countries, i.e. with Norway, Chile and Spain, it accounted for over 50% of the global total (Potts et al., 2016). Also, studies focusing on consumer preferences for sustainable aquaculture products have been mostly conducted in developed countries (i.e. US, EU, and Japan) (Cantillo et al., 2020; FAO, 2018a). Meanwhile, little efforts has been done to investigate the potential of sustainable seafood markets in developing countries, despite the fact that aquaculture production is mostly allocated in the Asia-Pacific region (about 90% of global production in 2015) (FAO, 2018a; Potts et al., 2016). Moreover, targeted species in these studies are mainly finfish rather than other groups of seafood such as crustacean and molluscs, even though the share of crustacean and molluscs production was about 44% of the finfish in 2016 (Cantillo et al., 2020; FAO 2018).

Market-based incentives (i.e. premium price for eco-certified products) are suggested the important drivers for producers participating in eco-certification schemes (Kim and Lee, 2018), showing the important role of the market demand for eco-certified seafood in sustainable

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aquaculture development, and hence the positive environmental outcomes. Seafood consumption in Asian countries is, however, expected to increase considerably alongside growing population, higher incomes, increased aquaculture production and international fish trade (Cantillo et al., 2020). At the regional level, in 2015, Asia had the highest share of fish consumption with 105.6 million tons (out of the 148.8 million tons total in the world) and was the third-biggest fish consumption per capital, with 24 kg/year, after the Oceania, with 25 kg/year, and the developed countries, with 24.9 kg/year (FAO 2018). Therefore, targeting Asian eco-certified seafood markets is essential for sustainable development of the aquaculture sector (FAO, 2018a; Jonell et al., 2013). The objective of this study is to investigate consumer preferences and demands for sustainable aquaculture products, using pond-raised shrimp in the south-central and south of Vietnam as a case study, thus provide the additional scientific evidences for consumer participation in supporting of the transition to sustainable aquaculture in Asia region generally and in Vietnam particularly.

Vietnam, in particularly, is an interesting case study since it is within the top 10 countries globally relying on fish as an important source of animal protein consumption, with an average consumption of 36.3 kg/capita in 2017 (FAO, 2018a, 2019). From a supplier aspect, Vietnam, with fish production of 6 million tons in 2015, was the world's fourth largest producer, in which aquaculture was the major contributor to fishery production with 3.4 million tons (FAO 2018). Shrimp is one of the major aquaculture products in Vietnam with 0.55 million tons of production in 2015, making Vietnam as the third-largest shrimp producer in the world after China (1.89 million tons) and Indonesia (0.6 million tons) (Weimin, 2017). The rapid growth of aquaculture shrimp production in Vietnam as well as in the seafood sector, however, has been plagued with perceptions of poor management and lack of social and environmental sustainability (Anh et al., 2011; Marschke and Wilkings, 2014). In response to the growing international concerns on the social and environmental sustainability as well as food safety issue, Vietnamese government, in 2002, invested in the better management practices (BMPs) and the good aquaculture practices (GAPs) standards, aiming to ensure better legislative compliance while providing a positive signal of the competency of Vietnamese farmers (Anh et al., 2011). Since 2006, the Vietnamese government has established a support plan and policies for the transition to sustainable aquaculture production, mainly to support farmers to comply with national and international standards (Anh et al., 2011). Despite international pressures (i.e. from importers and Food and Agriculture Organization of the United Nations) and Vietnamese government's efforts, the implementation of certified shrimp farming was at a very low rate, with 313 shrimp farms certified out of total approximately 600,000 in 2019 (Pongthanapanich et al., 2019)[1]. The main barrier preventing farmers adopting the standards is the high costs of compliance, whereas the government-led programs have some limitations due to the government budget dependent. Thus, without market-based incentives (i.e. premium price for certified farmed products) and government subsidies farmers are unlikely to deal with this (Anh et al., 2011; Marschke and Wilkings, 2014; Xuan and Sandorf, 2020). Nevertheless, the government-led programs should only be the short-term solution to promote farmers investing in sustainable aquaculture practices. In the long-term, the market-based incentive may be proper one, emphasizing the important of consumer participation in the transition to sustainable aquaculture. To date, there is no study aiming at assessing consumer preferences and demands for sustainable aquaculture products in Vietnam.

Shrimp has traditionally been marketed in Vietnam as homogeneous commodity (e.g., conventional or non-certified shrimp). However, there is a lack of market for eco-labelled products. It is often assumed that with little knowledge about sustainability, consumers in developing countries have no preference for eco-labelled products (Ward and Phillips, 2009), but several studies in Vietnam revealed that consumers have positive attitudes towards food products produced by the consideration of biodiversity conservation (Diep and Tuu, 2013; Khai and Yabe, 2015). Eco-labelled shrimp is new and unavailable in the marketplace in Vietnam, hence the demand for these products cannot be directly analysed. We, therefore, apply the discrete choice experiment (DCE) method to investigate consumer preferences and demands for eco-labelled shrimps in Vietnam, which is often referred to as "choice-based conjoint" (Lockshin et al., 2006; Roheim et al., 2012)

Particularly, this study determined whether consumers would place a value on eco-labelled shrimp product over a non-labelled one. The latter represents the conventional shrimp which is connected to unsustainable aquaculture production. Further, whether a first-party eco-certification (awarded by Vietnamese government) is valued differently from ones performed by international third-party certification bodies was also investigated. Consumer preferences for sustainable aquaculture shrimp products was assessed through the estimation of the consumer's willingness-to-pay (WTP) for farmed shrimp with/without eco-certification logo. Additionally, the predicted probabilities of choosing different types of shrimp as well as the direct- and cross-elasticity were calculated to further explore substitutability between these shrimp products. Previous studies applying DCE method to investigate consumer preferences for the sustainable products often included eco-label as an attribute among other product quality attributes (i.e. country of origin, production methods, feed usage, process, brand, etc.), which provides better information regarding trade-offs among attributes (Bronnmann and Asche, 2017; Bronnmann and Hoffmann, 2018; Carlucci and Devitiis, 2017; Del Giudice et al., 2018; Hinkes and Schulze-Ehlers, 2018). However, with more attributes about product quality provided to respondents, the eco-label, which can be considered as a "cue" attribute serving to convey information about unobservable quality attributes, might lose some of its role as a proxy for overall quality, thereby lower WTP estimate (Caputo et al., 2017; Gao and Schroeder, 2009; Jahn et al., 2005; Lusk et al., 2006). This study aims at investigating the important role of different eco-labels in predicting the stated purchasing behavior of sustainable farmed shrimp. Therefore, the choice sets used in this study included two attributes: eco-label and price, and their corresponding levels. The choice sets were presented in the labelled form. Alternatives in the choice set were labelled with different eco-certification logos (i.e. the levels of eco-label attribute) representing the eco-certified shrimps.

Consumer preferences for eco-labelled products can vary due to personality-related factors, e.g. self-perceptions regarding individual ability to positively influence the more sustainable aquaculture practices, which is often termed "perceived consumer effectiveness, PCE". Empirical analysis previously found the significant positive impact of PCE on consumer's attitude and behavior associated with sustainable products. For example, Vermeir and Verbeke (2006) explored the consumer "attitude – behavioral intention" gap and indicated that PCE among other psychological variables impacts positively on attitudes and behavioral intentions regarding purchasing of sustainable food products. Jonell et al. (2016) identified the determinants for "green consumption" and suggested that PCE is one of the main predictors of stated purchasing behavior of eco-labelled seafood and is an important component of decision-making process. In this study, we further explored the presumed difference in the WTPs, the choice probabilities, and elasticities of different types of shrimp with regards to consumer's self-perception in Vietnam, and hence filling in the gap of literature of attitude – behavior regarding "green consumption".

The rest of this paper is organized as follows. The second section presents materials and methods. The third section presents and discusses the results. The last section concludes the paper.

[1] There are currently no available statistics on number of shrimp farms. However, surveys conducted with Mekong Delta farmers in 2009–2010 showed a total average of 91.4% farms that are less than 1.0 ha (Lan, 2013; Nguyen et al., 2019), and the total shrimp farming area in Vietnam in 2016 was 694,645 ha (MARD, 2017).

2. Materials and methods

2.1. Data

DCEs have been widely used to investigate public preferences and WTPs for changes in environmental quality, including applied literature in seafood valuation (see e.g., Alfnes et al., 2006; Bronnmann and Asche, 2017; van Osch et al., 2017; Brayden et al., 2018; Bronnmann and Hoffmann, 2018). The advantage of this method compared to other (i.e. contingent valuation) is that DCE is more similar to a real buying situation, where respondents can choose the product that they prefer among a bundle of products or they can choose not to buy any product. The DCE approach is based on consumer theory and the concept of utility maximization as in Lancaster's consumer theory (Lancaster, 1966). Lancaster's consumer theory assumed that utility of a product is derived from its attributes rather than the product itself. In a DCE, based on this theory, a sequence of choice cards each consisting of a set of alternatives are presented to respondents choosing his/her preferred alternative. Each alternative includes several attributes that vary in terms of the level that they take. The concept of utility maximization implies that an individual chooses one alternative among others that provides him/her with the highest utility given that every choice is a rational decision making process. The various choice cards allow the random utility model to derive the underlying utility function for each product attribute (McFadden, 1974).

In this study, the DCE was conducted with farmed shrimp product and designed as so-called labelled experiment. This means that alternatives are labelled either with an eco-certification logo or without a logo named as "No-label". The latter represents the conventional product. There are four eco-certification logos selected for an examination of the consumer preferences and demand for eco-certified shrimp products. These logos currently represent the main certification schemes operating in Vietnam, including VietG.A.P (the Vietnamese Good Aquaculture Practices), GlobalG.A.P (the Global Partnership for Good Agricultural Practice), ASC (the Aquaculture Stewardship Council's) and Naturland. While GlobalG.A.P, ASC and Naturland are private international standards with certifications performed by independent, accredited third-party certification bodies, VietG.A.P is provided by Vietnamese government and is an example of first-party certification (Marschke and Wilkings, 2014). The price attribute of eco-labelled products consisted of 8 levels (i.e. 200, 230, 260, 290, 320, 350, 380, and 410 in thousand VND/kg for size of 30–40 individuals), while the price of "No-label" product had four levels (i.e. 170, 200, 230, and 260 in thousand VND/kg for size of 30–40 individuals).

The labelled experimental design for the variation of the levels of price across the five products was based on an efficient design using zero priors in order to obtain 32 choice tasks that were randomly blocked into 4 blocks of eight choice tasks each, using the design software NGENE (ChoiceMetrics, 2018). Each choice task consisted of five alternatives, four of them were labelled with an eco-certification logo and another with "No-label". A "no buy" option that is defined as "I am not going to buy any kind of shrimp" was included to make the buying decision more realistic, i.e. respondents were free to deny buying any of the offered alternatives. This design was then used for a pilot research with a sample of 40 respodents, each randomly allocated to one of the blocks and asked to select his/her most preferred alternative in each choice task. Based on the priors ontained from the pilot, the final design was updated by a Baysesian D-efficent experimental design optimized for the mutinomial logit model using the design software NGENE (ChoiceMetrics, 2018). To limit ordering effects, the order of the choice tasks as well as the order of the alternatives (excepting for "no buy" option) were rotated between respondents. Analysis of the responses following change to "no buy" option indicated that the six options attracted almost equally distributed numbers of bids, hence there was no evidence of significant status quo bias in the survey overall. A translated sample choice task is presented in Fig. 1.

Each survey questionnaire consisted of the following six parts: i) a brief introduction explaining the purpose of the surveys; ii) a background section seeking to explore the consumer's behavior in relation to their consumption of farmed shrimp; iii) a section trying to elicit the consumer's perceptions and attitudes towards conventional and sustainable shrimp aquaculture; iv) a section containing a brief introduction to the discrete choice experiment and the choice tasks; v) a section eliciting reasons for people choices; and, vi) a section gathering socio-demographics. Additionally, a cheap talk script was included in the survey with the purpose of reducing bias stemming from the hypothetical nature of the experiments that may increase the tendency of respondents to exaggerate stated opinions (Lusk, 2003). The cheap talk script was texted as follow: "Some people would state a higher price for an eco-certified product, but when this product become available in the market, they will not pay this price due to their budget limitation in the real world. We want you to behave as if you really had to pay for the product and took it home. Please response to each of following choice tasks as if you were in the market/supermarket".

The surveys were implemented face to face, in March and April of 2019, with a total of 353 people representing the general households in Khanh Hoa province and Ho Chi Minh city (HCMC) in Vietnam. Khanh Hoa was selected as representative province of the south-central region, given its typical both wild and farmed seafood producer/supplier. Thus, local consumers have experienced with various types of seafood products. HCMC was the representative of southern Vietnam because of its high population density. This combination of sampling is believed to provide a good picture of consumer's preferences for eco-labelled shrimp products in Vietnam. With the challenges of running large scale face-to-face surveys in a developing country and getting representative sample in the two regions, a random walk and quota sampling method was applied. The sample included male (38%) and female (62%) respondents from 19 to 72 years. A respondent was most likely female, in average age of 37 years, married, tertiary educated, and in full- or part-time employment with an average household income monthly of 23.7 million VND (approximately USD 1021). She lived in a four-person household, had responsibility for food shopping in her household, and bought shrimp for their meals 3 times averaged per month[2]. Descriptive statistics of key variables are presented in Table 1.

2.2. Econometric models

The analysis of discrete choice data is based on the random utility model (RUM) (McFadden, 1974), where the utility is composed of two components, deterministic and random. The indirect utility to respondent n of choosing alternative i in the choice situation t, U_{nit}, is expressed as follow

$$U_{nit} = V_{nit} + \varepsilon_{nit} = \beta X_{nit} + \varepsilon_{nit} \quad (1)$$

where the deterministic component V_{nit} includes the observable variables that related to the attributes of the goods, X_{nit}. β is a vector of coefficients of the variables. Random component, ε_{nit}, captures the factors that affect utility but are not observed by researchers and hence not included in V_{nit}. If the random components are independently and identically distributed (iid) as type 1 extreme values (Gumbel distributed), the RUM model is specified as the multinomial logit model (MNL) (McFadden, 1974). The standard logit expression is given as follow:

[2] Our sample is more female dominated (62% compared to 50.6%), older (37 years compared to 31), higher average household income (23.7 million VND compared to 13.6) and higher educated (tertiary educated 70% compared to 13.4%). Population data were retrieved from Statistics Vietnam (2018) (Accessed May 10, 2019).

Scenario 1	Shrimp labelled with				Shrimp without label	*I am not going to buy any kind of shrimp*
	VietGAP	GLOBALG.A.P.	FARMED RESPONSIBLY asc CERTIFIED ASC-AQUA.ORG	Naturland		
Price (*VND1000/kg for size 30-40 individuals/kg*)	200	320	290	290	230	
I choose						

Fig. 1. Sample of choice task.

Table 1
Sample characteristics.

	Mean	Standard deviation	Min	Max
Male	0.38	0.48	0	1
Age (years)	37.38	11.43	19	72
Married	0.72	0.45	0	1
Household size (persons)	4.11	1.44	1	12
Education				
Secondary and high school	0.14	0.34	0	1
Professional qualification of degree	0.11	0.32	0	1
Undergraduate degree	0.56	0.49	0	1
Graduate degree	0.14	0.34	0	1
Occupation				
Employed	0.84	0.37	0	1
Student	0.04	0.18	0	1
Retired	0.05	0.22	0	1
Main food shopper in the household	0.57	0.39	0	1
Number of children in the household (<16 years)	1	1	0	7
Household income per month (million VND)	23.73	16.77	4.5	200
Frequency buying farmed shrimp per month	2.81	1.83	0	6
Average price of farmed shrimp (VND/kg)	213	239	0	500
Province of resident				
Khanh Hoa	183			
Ho Chi Minh	170			

Note: At the time of the survey: USD 1 = VND 23,202.

$$P_{nit} = \prod_{t=1}^{T}\left[\frac{exp(\beta X_{nit})}{\sum_{j\in C} exp(\beta X_{nit})}\right] \quad (2)$$

The MNL model, however, is exposed with the three limitations, that are the assumptions of homogenous preferences across respondents, restricted substitution patterns (i.e. the independence of irrelevant alternatives - IIA property), and unobserved factors being unrelated over choices (Train, 2003). The mixed logit (MIXL) model is used for discrete choice data analysis to resolve these three limitations of the MNL model (Train, 2003). MIXL model is defined on the basic of the functional form for its choice probabilities. The mixed logit probabilities are the integral of standard logit probabilities over a density of parameters, can be expressed as follow:

$$P_{nit} = \int \prod_{t=1}^{T}\left[\frac{exp(\beta_n' X_{nit})}{\sum_{j\in C} exp(\beta_n' X_{njt})}\right] f(\beta|\theta)d\beta \quad (3)$$

where β parameters now vary across individuals, hence capturing heterogeneous preferences among respondents. The random parameters, β_n, are assumed following a specified distribution θ. The error terms of different alternatives are now allowed to be correlated. The integral does not have a closed-form solution, the parameters of the model are estimated through the simulated maximum likelihood estimation procedures following Train (2003).

Based on the estimated parameters, the marginal WTP for an alternative of shrimp i versus "none of these" is calculated as the negative ratio of the alternative specific constant (asc_i), that represents the marginal utility for the alternative i, to the price coefficient, as suggested by Lusk and Schroeder (2004).

$$WTP_i = -\frac{asc_i}{\beta_{price}} \quad (4)$$

This marginal WTP calculation, however, may present the potential problems because the asc_i, not only gives a measure of the marginal utility for a given alternative, but also pick up all sorts of effects that are not observed but influence the selection of the alternatives. To capture the systematic unobserved effects, we estimated the MNL and MIXL models where asc_i were interacted with individual characteristics (so-called covariates). The marginal WTP estimates and 95% confident intervals (CI) in the MNL model were calculated based on Eq. (4), using the Delta method. In the MIXL model, we simulated the mean WTP for each shrimp product, standard deviation, and 2.5 and 97.9 percentiles of the simulated WTP distributions based on the unconditional parameter estimates.

2.3. Perceived consumer effectiveness

PCE is an important factor influencing positively consumer purchasing decisions regarding the "green consumption", defined as the extent to which an individual believes she/he can contribute to better production practices by purchasing an eco-labelled alternative (Jonell et al., 2016; Straughan and Roberts, 1999; Vermeir and Verbeke, 2006). In this study, the PCE was assessed by asking respondents to what extent they believed that they as individuals can contribute to more sustainable aquaculture practices by buying eco-labelled shrimp products. I.e. "To what extent do you believe you as a consumer can contribute to more sustainable aquaculture by purchasing eco-labelled alternatives?", with responses using a five-point Likert scale where 1 was "Not at all" and 5 was "In a very high extent"[3]. The responses with either 5th or 4th level to the question above were recoded as "1" referring to "high PCE" and other responses were recoded as "0" with the meaning of "low PCE". Almost three-fourths (74%) of our respondents stated their highly beliefs that purchasing the eco-labelled products can contribute to sustainable aquaculture practices in Vietnam (see Fig. 2).

[3] It is suggested that multi-item scales are preferred in the survey instruments, though the single-item measure is also considered to accurately capture a certain factor, e.g. PCE (Jonell et al., 2016).

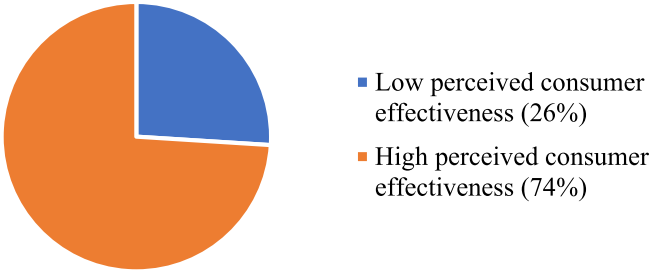

Fig. 2. Consumer self-perception.

3. Results and discussion

3.1. Consumer preferences for farmed shrimp with/without eco-certification logos

Both models, MNL and MIXL, were estimated in NLOGIT 6.0. In the MIXL model, 3000 modified Latin hypercube sampling (MLHS) random draws per respondent and random parameter was used. All the alternative specific constants were specified as random following a normal distribution. The price parameter was assumed to be one-side triangular distributed, where the spread is constrained to be equal to the mean. This is shown to be an appealing way of capturing the random taste heterogeneity and avoiding the search for heterogeneity at the extremes of unconstrained distributions (Hensher and Rose, 2009)[4]. The estimation of the MNL and MIXL model with/without interaction is presented in Table 2[5]. Covariates such as education and income, which insignificantly influenced the selection of any alternative (i.e. non-significant interaction parameters), were excluded from the estimations as suggested by Hensher et al. (2005). The comparison between the results of models with interaction and that of models without interaction shows the systematic unobserved effects that influence the selection of farmed shrimp products. Results from the MIXL models indicate individual heterogeneous preference for farmed shrimp products. Hence, we focus on presenting and discussing the results of the MIXL model with interaction.

The positive and highly significant alternative specific constants implied that the consumers would prefer having one of the farmed shrimp products than having nothing at all, holding the price constant. Farmed shrimp labelled with eco-certification logos were preferred than the conventional shrimp. Of the four eco-certified shrimps, consumers will get the largest utility when they buy shrimp labelled with ASC logo, followed by GlobalG.A.P and Naturland logos, while purchasing shrimp labelled with VietG.A.P logo will bring them the lowest utility. The price coefficient was negative and highly significant indicating that an increase in price will decrease the utility of consumer and hence lower the likelihood of purchasing. The standard deviation estimates regarding the alternative specific constants were statistically significant, indicating that preferences for different types of farmed shrimp are heterogeneous among respondents. The means of the alternative specific constants were positive and substantially higher than the corresponding

[4] A MIXL model with log-normal distributed price random parameter was estimated, however the estimates of WTP were implausible. The author also estimated a MIXL model with fixed price parameter and correlated random parameters, but the model fit was not improved from the current MIXL model, though random parameters were strong correlated. A MIXL model in WTP space failed to converge.

[5] We recognized that our sample consists of more female, older, richer and higher educated individuals. To control for the skewness of our sample, we estimated models using "population weights" created by gender, age and education, but not income due to the limited census data availability. However, given the correlation between age, education and income, we believe that variation is substantially captured.

Table 2
Model estimate results (standard errors in the parentheses).

	MNL	MNL with interaction	MIXL	MIXL with interaction
Parameters				
Price	−0.012***	−0.013***	−0.033***	−0.033***
	(0.004)	(0.004)	(0.001)	(0.002)
$asc_{VietG.A.P}$	4.775***	2.421***	12.101***	6.726***
	(0.136)	(0.423)	(0.475)	(1.443)
$asc_{GlobalG.A.P}$	4.157***	2.770***	10.982***	8.507***
	(0.136)	(0.446)	(0.447)	(1.357)
asc_{ASC}	3.659***	3.210***	10.417***	9.539***
	(0.135)	(0.485)	(0.427)	(1.318)
$asc_{Naturland}$	3.690***	2.746***	10.384***	7.932***
	(0.134)	(0.463)	(0.428)	(1.271)
$asc_{Nolabel}$	2.803***	3.061***	6.856***	6.390***
	(0.115)	(0.490)	(0.501)	(1.558)
Standard deviations				
Price			0.033***	0.033***
			(0.001)	(0.002)
$asc_{VietG.A.P}$			2.782***	2.535***
			(0.231)	(0.228)
$asc_{GlobalG.A.P}$			1.931***	1.790***
			(0.208)	(0.230)
asc_{ASC}			1.633***	1.515***
			(0.229)	(0.229)
$asc_{Naturland}$			1.584***	1.659***
			(0.260)	(0.245)
$asc_{Nolabel}$			3.912***	3.283***
			(0.424)	(0.347)
Interaction terms with the covariate "Household size"				
$asc_{VietG.A.P}$		−0.320***		−0.743***
		(0.060)		(0.210)
$asc_{GlobalG.A.P}$		−0.044		−0.402**
		(0.064)		(0.192)
asc_{ASC}		−0.229***		−0.692***
		(0.069)		(0.183)
$asc_{Naturland}$		−0.173***		−0.613***
		(0.067)		(0.188)
$asc_{Nolabel}$		−0.823***		−1.466***
		(0.079)		(0.245)
Interaction terms with the covariate "Number of children living in the household"				
$asc_{VietG.A.P}$		0.909***		2.101***
		(0.108)		(0.366)
$asc_{GlobalG.A.P}$		−0.049		0.735**
		(0.122)		(0.336)
asc_{ASC}		0.377***		1.098***
		(0126)		(0.328)
$asc_{Naturland}$		0.495***		1.342***
		(0.121)		(0.324)
$asc_{Nolabel}$		1.245***		2.695***
		(0.123)		(0.392)
Interaction terms with the covariate "Main food shopper in the household"				
$asc_{VietG.A.P}$		1.877***		2.352***
		(0.228)		(0.778)
$asc_{GlobalG.A.P}$		1.616***		1.603**
		(0.243)		(0.735)
asc_{ASC}		2.006***		2.353***
		(0.485)		(0.688)
$asc_{Naturland}$		1.121***		1.372***
		(0.252)		(0.694)
$asc_{Nolabel}$		2.674***		4.440***
		(0.253)		(0.856)
Interaction terms with the covariate "Frequency buying farmed shrimp per month"				
$asc_{VietG.A.P}$		0.046(0.055)		0.253(0.184)
$asc_{GlobalG.A.P}$		0.037(0.058)		0.329*(0.180)
asc_{ASC}		0.117*		0.397**
		(0.062)		(0.171)
$asc_{Naturland}$		0.129**		0.376**
		(0.060)		(0.172)
$asc_{Nolabel}$		0.010(0.063)		−0.009
				(0.207)
Interaction terms with the covariate "Male"				
$asc_{VietG.A.P}$				

(continued on next page)

Table 2 (*continued*)

	MNL	MNL with interaction	MIXL	MIXL with interaction
		1.874***		2.299***
		(0.205)		(0.676)
$asc_{GlobalG.\ A.\ P}$		1.894***		1.864***
		(0.220)		(0.635)
asc_{ASC}		1.026***		0.669(0.603)
		(0.232)		
$asc_{Naturland}$		1.189***		1.096*(0.605)
		(0.225)		
$asc_{Nolabel}$		1.692***		2.588***
		(0.226)		(0.736)
Interaction terms with the covariate "Age"				
$asc_{VietG.\ A.\ P}$		0.040***		0.119***
		(0.009)		(0.028)
$asc_{GlobalG.\ A.\ P}$		−0.010		0.024(0.027)
		(0.010)		
asc_{ASC}		0.009(0.010)		0.047*(0.026)
$asc_{Naturland}$		0.016(0.010)		0.068***
				(0.025)
$asc_{Nolabel}$		0.024**		0.085***
		(0.010)		(0.028)
Interaction terms with the covariate "Married"				
$asc_{VietG.\ A.\ P}$		−0.520**		−1.337*
		(0.239)		(0.746)
$asc_{GlobalG.\ A.\ P}$		0.581**		0.289(0.714)
		(0.263)		
asc_{ASC}		−0.995***		−1.853***
		(0.270)		(0.697)
$asc_{Naturland}$		−0.617**		−1.073
		(0.265)		(0.704)
$asc_{Nolabel}$		−1.564***		−3.744***
		(0.260)		(0.883)
Model statistics				
Observation	2824	2824	2824	2824
Parameter	6	41	11	46
Log likelihood	−3703.288	−3402.264	−2457.961	−2372.298
Pseudo *r*-squared	0.122	1.193	0.444	0.463
AIC/N	2.627	2.439	1.749	1.713
BIC/N	2.640	2.525	1.772	1.810
Likelihood ratio test		602.048***		171.326***

Note: *** =1% significance level; ** = 5% significance level; * = 10% significance level.

standard deviations, suggesting that most of the population placed a positive value on shrimp products. Particularly, almost 100% of the population were estimated to prefer eco-certified shrimps, whereas about 97% of the population prefer non-labelled shrimp.

The heterogeneity in preference for different farmed shrimp products were related to individual specific characteristics. Specifically, the interaction terms of the asc_i with the covariates "age", "male" and "main food shopper in the household" were positive and significant, showing that a male, older and being main food shopper in the household, had higher preference for all types of shrimp regardless of certified or non-certified product. However, consumer who has been married and connected to a bigger household size showed a lower preference for those shrimp products. All interaction terms of the asc_i related to the third-party eco-labelled shrimps with the covariate "frequency buying farmed shrimp per month" were positive and significant, indicating a higher preference for these types of shrimp compared to less frequent buyers.

Certification logos awareness can influence consumer preferences for eco-labelled seafood (Jonell et al., 2016), it alone yet may not sufficiently explain consumer preferences for eco-certification logos (Janssen and Hamm, 2012). In this study, VietG.A.P logo was the most recognized and understood by the consumers, but it had lowest premium price. While the ASC logo had highest premium price, but was least recognized by the consumers (see Fig. 3 and Table 3). This is not necessarily an

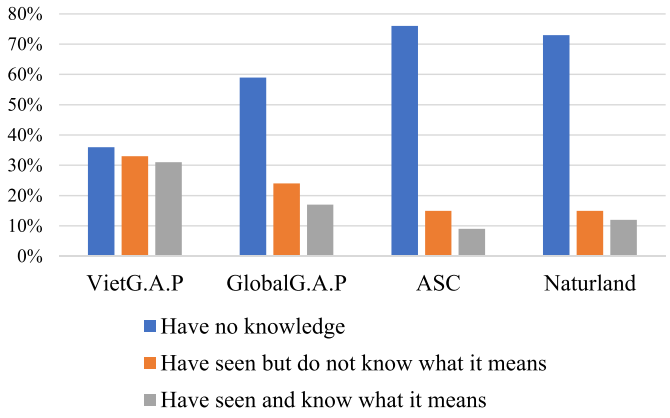

Fig. 3. Consumer knowledge towards sustainable certification labels.

Table 3
WTP for different shrimp products (VND 1000/kg).

Labels	MNL with interaction		MIXL with interaction			
	Mean	95% Confidence Interval	Mean	Standard deviation	Quantile	
					2.5%	97.5%
VietG.A.P	183***	[122; 244]	256***	281	35	792
GlobalG. A.P	209***	[145; 274]	325***	316	106	961
ASC	243***	[173; 312]	365***	343	138	1057
Naturland	208***	[141; 274]	303***	295	199	896
Nolabel	231***	[160; 303]	242***	294	−25	821

Note: *** =1% significance level

unexpected result. Consumer perceptions and attitudes associated with the specific certification scheme behind the logo, that were not explicitly investigated in this study, might play an important role in the explanation of consumer preferences for eco-labelled products (Janssen and Hamm, 2012). Nevertheless, the effect of certification logo awareness on consumer preferences for eco-labelled shrimp was reported in this study, i.e. the highest predicted probability of selecting product was related to shrimp labelled with VietG.A.P logo (see Table 5).

For understanding the important role of each eco-certification in relation to the consumer choice, the marginal WTP estimates are reported in Table 3. In the MIXL model, the mean marginal WTP for the conventional farmed shrimp was lower (in absolute term) compared to that of the eco-labelled shrimps. Consumers were willing to pay 242 thousand VND per kilogram for conventional farmed shrimp with size of 30–40 individuals, which was quite close to the observed market price (i.e. in the range of 200–250 thousand VND per kilogram, at the time survey conducted, depending on different open markets and locations). The estimated price was a bit higher than the mean price per kilogram of shrimp observed from the sample, i.e. 213 thousand VND per kilogram (see Table 1). This result is consistent with the previous studies on food consumption, which indicate that DCEs may introduce hypothetical bias, i.e. higher predicted probability of selecting goods than when payment is actually required, and hence overestimated WTP for a specific commodity (Lusk and Schroeder, 2004). However, the higher predicted price, compared to the lower observed price in this study, can be the result of the variation of shrimp quality (i.e. size of shrimp, freshness of shrimp, type of shrimp, etc.) that consumers purchased, rather than the hypothetical shrimp in the choice experiments with the specific standards. Of the four types of eco-labelled shrimp, consumers were willing to pay the highest premium price (in absolute term) for shrimp labelled with ASC logo (i.e. 365 thousand VND per kilogram), followed by GlobalG.A.P, Naturland and VietG.A.P logo (i.e. 325, 303 and 256 thousand VND per kilogram, respectively). Generally, consumers were willing to pay more for eco-labelled shrimps, from 14 to 123 thousand

VND per kilogram (about 6% to 51% premium), compared to the conventional shrimp.

Estimates of WTP for different types of farmed shrimp regarding different levels of consumer self-perception are shown in Table 4. Consumers were divided into two groups based on their PCE scores: those with a score of 1–3 were classified into the low PCE group, and 4–5 into the high PCE group. The results in Table 4 show that the high PCE group had the larger WTPs for all types of farmed shrimp compared to the low PCE group. However, the impact of PCE levels on WTPs for eco-labelled shrimps were also recorded. When comparing the relative increases in WTP for eco-labelled shrimp over conventional shrimp between high and low PCE group, we saw higher increases regarding the high PCE group (within the range of 26% and 84% premium) than the low PCE group (within the range of 3% and 31% premium). This implies that consumers with higher belief that she/he can contribute to more sustainable aquaculture production by purchasing an eco-labelled alternative will have higher demand for eco-labelled products than consumer with lower self-perception. This finding is consistent with literature of sustainable consumption, indicating that high level of PCE is necessary for consumer change in purchasing behavior (Vermeir and Verbeke, 2006).

3.2. Elasticity measures and choice probability

This section gives further information related to consumer behavior, i.e. shrimp purchase decision, through the calculation of direct (or own-price) and indirect (or cross) elasticities, as well as the predicted probabilities of choosing these products. The direct elasticity measures the percentage change in the probability of selecting a particular shrimp alternative in the choice card with respect to a given percentage change in purchase price, while the cross elasticity measures the percentage change in the probability of choosing a specific shrimp alternative in the choice card with regard to a given percentage change in a competing alternative, ceteris paribus (Hensher et al., 2015).

Table 5 provides the full matrices of direct-point (in diagonal) and cross (in off-diagonal) elasticities of different farmed shrimp products with respect to purchase price (VND 1000/kg) as well as the choice probabilities. All were simulated using the results from the MIXL model with correlation. The MIXL model captures the consumer preference heterogeneity and relaxing the independence of irrelevant alternatives (IIA) assumption, hence obtaining the meaningful and asymmetric cross-elasticity (Hensher et al., 2013). Own-price elasticities were all negative signs confirming the inverse relationship between demand and price, and greater than 1 in the absolute (though they varied among different types of shrimp) implying that shrimp generally was a type of product having relative elastic demand, or in other words, consumers are sensitive to the change in the price. Consumers were more sensitive to the change in price of the eco-labelled shrimps than the conventional shrimp, with an exception of shrimp labelled with VietG.A.P logo (i.e. the elasticity of the shrimp labelled with VietG.A.P logo was slightly lower than that of the conventional shrimp). Higher elasticity of eco-labelled shrimp, however, is not necessary a signal of the lower demand for consuming sustainable aquaculture products because the higher price elasticities of eco-labelled shrimp may be the consequences of the higher levels of price set up for the eco-labelled shrimp in the design of the choice sets. Nevertheless, higher demand for sustainable aquaculture shrimp was reported through the probability of selecting a specific shrimp, given that the mean predicted choice probabilities of eco-labelled shrimps were higher than that of "No-label" shrimp. The highest predicted choice probability recorded to the shrimp labelled with VietG.A.P logo was 28.6%, followed by GlobalG.A.P (17.6%), ASC (14.8%), Naturland (12.8%) and "No-label" shrimp (12.7%).

Own-price elasticity of the conventional shrimp ($|E| = 2.3$) in this study was higher than that found in other studies ($|E| = 1.6$) using time series data for shrimp elasticity estimation (Phong and Thai, 2019; Zhou, 2015). Even though the premium for conventional shrimp is close to the actual market price. This might be because, in this study, it was focused on the same product (farmed shrimp), non-labelled versus labelled with different eco-certification logos that are very closely substitutability, rather than a set of food (i.e. beef, pork, chicken, fish, shrimp, etc.) as in previous studies[6].

Of the four types of eco-labelled shrimp, shrimp labelled with VietG.A.P logo exhibited the lowest price elasticity, suggesting that consumers were less sensitive to the change in price of shrimp being certified by national body than those being certified by the internationally third-party bodies, thus the difference in market demand. This difference appears to be reflected by the difference in consumer knowledge related to eco-certification logos as presented in Fig. 3.

Cross-price elasticities were all positive signs and less than 1, providing information of the degrees of product substitutability (but weakness) between the conventional and eco-labelled shrimps, as well as among eco-labelled shrimp themselves, given an increase in purchasing price. Cross-price elasticities should be read horizontally. For example, given 1% increase in the price of shrimp labelled with VietG.A.P logo, the probability of choosing this shrimp would decrease by 2.238%, while the choice probability of shrimp labelled with GlobalG.A.P logo would increase by 0.833%, ceteris paribus.

Table 6 reports the direct-point elasticity of different types of shrimp regarding two levels of PCE and the corresponding choice probability. Consumers with low PCE level, who do not believe that the individual's actions (i.e. buying an eco-certified alternative) will significantly contribute to better aquaculture practices, showed more sensitive to the change in the price (regardless shrimp labelled with an eco-certification logo or not) compared to the high PCE group. Low PCE group was more sensitive to the change in the price of the eco-labelled shrimps compared to the conventional shrimp, and had the least price sensitivity related to shrimp labelled with VietG.A.P logo compared to others eco-certified. The demand for farmed shrimp associated with the high PCE consumers showed the same general pattern of the sample population. I.e. shrimp labelled with VietG.A.P logo showed lower price elasticity compared to the conventional shrimp, while there was a higher elasticity for the remaining eco-certified shrimps. In terms of choice probability, the high PCE consumers had higher probabilities of choosing eco-labelled shrimps but lower probability of choosing the conventional product compared to those of the low PCE group. These findings suggest an important role of PCE in terms of sustainable aquaculture consumption.

4. Conclusions and policy implications

To date, only a small proportion of world aquaculture production is certified and predominantly consumed in the US and EU, with limited coverage of Asian markets (Bush et al., 2013; Cantillo et al., 2020; FAO, 2018a; Jonell et al., 2013). Farmed seafood, however, is mainly produced in Asia-Pacific region, and about two-thirds of all seafood is consumed in Asia (Jonell et al., 2013; Marschke and Wilkings, 2014), raising the question: what is the role of Asian consumers regards to the transition to sustainable aquaculture production?. In this study, consumer preferences for sustainable aquaculture products were investigated, using the case of Vietnamese farmed shrimp products. The findings indicated that the proposed model specification proved to be

[6] It is indicated that marginal WTP for attributes can be similar between the hypothetical and non-hypothetical settings, but the predicted probabilities are generally higher in the hypothetical setting than when payment is actually required (Lusk and Schroeder, 2004). Therefore, the empirical elasticities derived from the DCE data may have potential problems because the elasticity is a function of the relevant parameters, attribute levels and the associated choice probability (Hensher et al., 2015). However, due to the lack of actual market data for eco-labelled shrimp products, model calibration to obtain meaningful estimates of elasticities was not possible.

Table 4
Consumers' WTP estimates (VND 1000/kg) by different levels of PCE, using MIXL model with interaction.

	Low PCE				High PCE			
	Mean	Standard deviation	Quantile		Mean	Standard deviation	Quantile	
			2.5%	97.5%			2.5%	97.5%
VietG.A.P	225	307	81	509	298	371	21	1104
GlobalG.A.P	236	304	94	534	434	469	127	1387
ASC	286	366	114	645	435	443	159	1303
Naturland	267	322	116	603	291	345	45	1021
No-label	218	330	5	495	236	362	−93	1096

Table 5
Elasticity measures and choice probability, using MIXL model with interaction.

	VietG.A.P	GlobalG.A.P	ASC	Naturland	No-label	Choice probability
VietG.A.P	−2.238	0.833	0.845	0.924	0.980	0.286
GlobalG.A.P	0.494	−2.645	0.560	0.601	0.465	0.176
ASC	0.401	0.451	−2.807	0.524	0.457	0.148
Naturland	0.388	0.417	0.435	−3.004	0.395	0.128
No-label	0.301	0.273	0.329	0.328	−2.305	0.127

Note: The diagonal estimates are direct-point elasticities and the off-diagonal estimates are cross elasticities.

Table 6
Direct elasticities measures by different levels of PCE, using MIXL model with interaction.

	Low PCE		High PCE	
	Price elasticity	Choice probability	Price elasticity	Choice probability
VietG.A.P	−3.016	0.232	−1.826	0.315
GlobalG.A.P	−3.315	0.118	−2.183	0.208
ASC	−3.293	0.121	−2.484	0.150
Naturland	−3.680	0.110	−2.516	0.133
No-label	−2.372	0.199	−1.921	0.098

especially useful for policymakers in terms of sustainable aquaculture development and for marketers designing the effective marketing strategies in the retail food sector. Four main policy implications can be drawn.

Firstly, a majority of consumers in Vietnam prefer shrimp product. They place higher value on eco-labelled shrimps compared to conventional shrimp, thus they are willing to pay a premium price for eco-labelled shrimps, although the preferences for the tested shrimps vary across respondents. Additionally, consumer demand for farmed shrimp, in general, is relative elastic. Eco-labelled shrimps are viewed imperfect substitutes for the conventional shrimp. These findings provide opportunities for seafood producers to implement alternative marketing strategies on product differentiation as well as effective pricing policies. Further, premium price for eco-labelled products can promote social, environmental, and economic sustainability of aquaculture industry since it indicates a return on the investment of sustainable aquaculture practices, providing economic incentive for the farmers to undertake such practices, resulting in the minimization of negatively environmental impacts. The results show a premium of 6%–51% for eco-labelled shrimps compared to conventional shrimp. However, it remains an open question: is the premium sufficient to cover the increased cost of production incurred from sustainable aquaculture and certification? The answer for this question will leave for further research.

Secondly, consumers, who have more knowledge in relation to VietG.A.P logo, are more likely to choose products certified according to VietG.A.P standard, even though they are only willing to pay the lower premium price compared to others certified according to standards of GlobalG.A.P, ASC, and Naturland. Food eco-labels provide information of attributes related to production practices and some enhanced features of the products that consumers ask for but cannot be observed without a label such as organic and animal welfare (Jahn et al., 2005). Hence, recognition of eco-certification logos and knowledge on how food is produced, and the environmental implications of sustainable production are important factors determining eco-labelled seafood purchasing behavior. This suggests that consumers' familiarity with different eco-certification logos needs to be improved, e.g. by implementation of marketing communication activities. This could also help to solve problems associated with asymmetric information among producers, retailers, and consumers, resulting in perceived risk reduction (Chege and Groote, 2008; Mceachern and Warnaby, 2008).

Thirdly, the observed preference of Vietnamese consumers for VietG.A.P certification may be a good signal for farmers who want to implement sustainable aquaculture practices. VietG.A.P is a set of national standards for Good Aquaculture Practices. Farmers complying with VietG.A.P standards will receive supports from the government, e.g. administrative, assessment, and training costs, and certification fees. Hence the cost for implementing VietG.A.P will be much lower than international certifications (i.e. GlobalG.A.P and ASC) (Marschke and Wilkings, 2014). However, it should be noted that a large proportion of Vietnamese shrimp products are exported, and that importers in the three major markets, i.e. EU, US, and Japan, are not interested in VietG.A.P certification. Nevertheless, complying with VietG.A.P standards is considered the most feasible initially, given that it will be very difficult and expensive for farmers to start with GlobalG.A.P or ASC standards. Although there are different approaches to certain aspects of sustainability among the certification schemes, they cover similar key criteria associated with social, environmental, economic and management (Marschke and Wilkings, 2014). Therefore, once farmers adopt VietG.A.P, they can easily upgrade to other international certificates required by importing countries, with reduced certification fees for these certificates. Thus, gaining wider acceptance in both domestic and international markets (Marschke and Wilkings, 2014; Nguyen, 2015).

Fourthly, consumers are clearly not a homogeneous preference group. The findings in this study show that respondents, who perceive that the individual actions are significant for a better aquaculture production were willing to pay more for eco-labelled shrimp products. This suggests that more sustainable food consumption can be stimulated through raising PCE via communication strategies. For group of consumers with high PCE, communication should be focused on the rightness of their behavior, e.g. emphasizing the linkage of benefits between individual consumers, environment, and society in relation to sustainable consumption (Vermeir and Verbeke, 2006). Whereas, a more

feasible communication strategy is needed to enhance involvement of low PCE consumers towards sustainable consumption by focusing on the personal benefits of sustainable products that satisfies the "selfish" needs (Vermeir and Verbeke, 2006).

To conclude, there is potential for eco-labelled shrimp consumption, and thus corresponding sustainable aquaculture production to be developed in Vietnam, though several features need to be studied further. For example, interactions between farmers, retailers, consumers, and policymakers, who are the key actors in the value chain, affecting the demand for sustainable consumption and production, must be clarified. The results suggest that DCE is a useful method for studying consumer preferences for other markets in relation to "green consumption" in developing countries.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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