



Consumer attitudes and preferences towards pangasius and tilapia: The role of sustainability certification and the country of origin

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ARTICLE INFO

Keywords:

Aquaculture
Consumer behavior
Discrete choice experiment
Ethnocentrism
Mixed logit
Willingness-to-pay

ABSTRACT

The majority of farmed fish produced in Bangladesh is consumed domestically, while global demand for fish is increasing. Non-tariff barriers resulting from consumers' concerns about sustainability and food safety or attitudes towards the country of origin might be one reason for limited export. The purpose of this study is to analyze consumer preferences for frozen pangasius and tilapia fillets from Bangladesh in order to explore market opportunities in Germany. A discrete choice experiment was conducted to estimate marginal utilities and willingness-to-pay for different product attributes, focusing on sustainability certification and the country of origin. Vietnam as a major exporter of pangasius to Germany was selected as a reference country for the analysis. The results of fitted mixed logit models indicate that German consumers are price-sensitive and prefer fish produced in Germany over fish farmed in either Bangladesh or Vietnam. While this finding seems not to be attributable to consumer ethnocentrism, country image constructs might play a role. A significant positive utility was identified for both sustainability and fair trade certification. The overall opt-out rate of the choice experiment was relatively high, indicating a general reluctance to consume pangasius and tilapia. Older respondents as well as those concerned about sustainability and those having less positive attitudes towards aquaculture were more likely to opt out. Overall, concerns about sustainability and the country of origin are relevant factors influencing purchase decisions, but aspects of taste and preferences for certain fish species might be even more significant in this context, limiting the market potential of pangasius and tilapia in Germany.

1. Introduction

Global demand for fish is increasing due to the growing world population and a rising middle class in Asia in particular. With marine stocks facing depletion, it is expected that aquaculture production will continue to expand to meet this demand (FAO, 2016; Little et al., 2012). The European Union (EU) is the largest market for fish products in terms of import volumes and has become even more dependent on imported fish in the recent past (FAO, 2016). Bangladesh is currently the world's sixth largest producer of fish from aquaculture in total volumes (FAO, 2016). A demand-driven expansion of aquaculture production might stimulate the local economy and thereby contribute to employment generation. Currently, less than ten percent of farmed fish produced in Bangladesh are being exported (Hernandez et al., in press). Tilapia and pangasius are aquaculture species which have just recently become relevant as export goods from the 'Global South' to the 'Global North' (Belton, Haque, Little, & Sinh, 2011). According to production volumes, pangasius is nowadays the most important species farmed in aquaculture in Bangladesh, but compared to Vietnam, export is so far

very limited. In Bangladesh, pangasius usually refers to the species *Pangasianodon hypophthalmus* (Ali, Haque, & Belton, 2013). The common tilapia species are *Oreochromis niloticus* (Nile tilapia) and *Oreochromis mossambicus* (Mozambique tilapia) (Ali et al., 2013; Bjørndal, Child, & Lem, 2014). Traditional pond systems often combine pangasius with tilapia and carp farming in polyculture (Ali et al., 2013). A large number of rather small-scale producers are involved in pond aquaculture, with a mean pond size of one hectare in Bangladesh, while in the recent past the development of aquaculture value chains has been characterized by intensification and vertical integration (Belton et al., 2011; Hernandez et al., in press). While producers in Vietnam and Bangladesh use natural pond aquaculture systems, indoor recirculating aquaculture systems (RAS) need to be installed for production in Germany to compensate for unfavorable environmental conditions, as the water temperature of natural waters would not be suitable for pangasius and tilapia aquaculture (BLE, 2017; Badiola, Mendiola, & Bostock, 2012; Brämick, 2015). In the recent past, the number of producers using RAS in Germany has been increasing. While African sharp-toothed catfish and European eel are the most common species farmed in

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German RAS, there is also some tilapia and pangasius production, although still in rather small quantities (BLE, 2017).

Compliance with product standards, technical standards, hygiene standards, and other relevant regulations in developed countries are major obstacles for producers from developing countries (FAO, 2016). The excessive use of antibiotics and other chemical substances poses a threat to aquaculture sustainability by negatively affecting food safety and environmental conditions (Phuong & Oanh, 2010). In some places, groundwater is used for intensive aquaculture production, leading to groundwater depletion and reduced water quality (Anka, Faruk, Hasan, & Azad, 2013). Other negative consequences of intensified aquaculture production in general are deforestation of mangrove forests and the endangerment of local biodiversity by invasive species (Prein & Scholz, 2014). A significant proportion of wild-caught fish is used to produce fish oil and fishmeal as feed for farmed fish and other animals and is therefore not available for direct human consumption (Washington & Ababouch, 2011).

In German supermarkets, pangasius and tilapia are usually sold in the form of pre-packed frozen fillets. Credence qualities of these products, such as safety, quality and sustainability related to the production process and the product itself, can hardly be recognized in the end product due to information asymmetry (Verbeke & Roosen, 2009; Washington & Ababouch, 2011). Consumers might base their valuation of a product's qualities on their attitudes and beliefs with regard to the product's country of origin in order to deal with the perceived lack of reliable information (Loureiro & Umberger, 2003). Sustainability labels could be used as extrinsic quality indicators for aquaculture products, reducing the level of information asymmetry. Voluntary sustainability standards and certification schemes have been developed in the recent past to increase value chain transparency and to enable consumers to incorporate sustainability-related aspects in their purchase and consumption decisions (Belton et al., 2011; Grunert, Hieke, & Wills, 2014; Parkes et al., 2010; Washington & Ababouch, 2011). The effects of sustainability claims or labels on consumer choice have been investigated in a number of studies which found significant and positive effects (e.g. Bronnmann & Asche, 2017; Carlucci et al., 2015; Risius, Janssen, & Hamm, 2017). For fish originating from developing countries, however, comparable studies are missing, although these are of tremendous importance for producers in the respective countries as well as the value chains they are part of. Against this background, the main objective of this study is to analyze German consumers' preferences and willingness-to-pay for different product attributes of pre-packed frozen pangasius and tilapia fillets. In particular, it should be examined whether the country of origin as well as sustainability and fair trade certification might influence purchasing decisions.

2. Research hypotheses derived from the literature

Various studies have revealed the importance of information on the country of origin as extrinsic cue for fish consumption decisions (e.g. Claret et al., 2012; Jaffry, Pickering, Ghulam, Whitmarsh, & Wattage, 2004; Lawley, Birch, & Hamblin, 2012). A domestic-country bias for fish from consumers' country of origin has been identified for instance by Claret et al. (2012) in Spain and by Jaffry et al. (2004) for the United Kingdom. Some people tend to prefer domestically produced products over products imported from abroad just for patriotic reasons, as they feel the need to support and protect the domestic economy which they regard as being superior to others. To measure this trait called consumer ethnocentrism, Shimp and Sharma (1987) developed the consumer ethnocentric tendencies scale (CETSCALE) which has since been widely applied in research to measure CE in different countries (e.g. Balabanis & Diamantopoulos, 2004; Evanschitzky, Wangenheim, Woisetschlager, & Blut, 2008; Jiménez-Guerrero, Gázquez-Abad, & Linares-Agüera, 2014; Shimp & Sharma, 1987).

A recently published comprehensive literature review on determinants of fish and seafood consumption behavior summarized the results

of 49 studies and confirmed that eco-labeling and the country of origin (COO) belong to the most important attributes people consider in their purchase and consumption decisions (Carlucci et al., 2015). However, these issues have not been explicitly studied in the scientific literature in the context of exporting pangasius and tilapia from Bangladesh to Germany so far. Taking into account previous research results on country-of-origin effects and the relevance of COO labeling, it is assumed that the COO of pangasius and tilapia influences choice behavior. A domestic-country bias in favor of German products is expected. It should be further analyzed to what extent ethnocentric tendencies influence consumer behavior, based on the assumption that the level of consumer ethnocentrism is positively related to preference for domestic products. Consumers might also develop cognitive images of certain countries based on previous experience or information, for instance related to product and process quality. It should be assumed that the better the country image consumers associate with a certain COO, the more likely they are to choose a product from the respective country.

Relevant sustainability standards for aquaculture products are provided by Friend of the Sea, GlobalG.A.P., Naturland, the Aquaculture Stewardship Council (ASC), and the Best Aquaculture Practices (BAP) developed by the Global Aquaculture Alliance (GAA) (Bush et al., 2013; Parkes et al., 2010; Prein & Scholz, 2014). Both ASC and Naturland are business-to-consumer standard setters relevant for the German market. The ASC standards for pangasius and tilapia comprise farm-level standards and regulations for independent third-party audits. Requirements are for instance related to the conservation of biodiversity, natural habitats and water resources, the responsible use of resources needed for aquaculture, the protection of fish health as well as human health, and socially responsible working conditions (ASC, 2012a, 2012b). The Naturland Standards for Organic Aquaculture follow stricter requirements than ASC standards in some areas, for instance related to animal welfare, and prohibit the use of chemicals and genetically modified organisms (GMOs) (Naturland, 2017).

Results from several studies conducted in different countries have shown that consumers pay attention to sustainability certification and express a positive willingness-to-pay (WTP) for eco-labeled fish products (e.g. Bronnmann & Asche, 2017; Carlucci et al., 2015; Jaffry et al., 2004; Risius et al., 2017; Salladarré, Guillotreau, Perraudeau, & Monfort, 2010; Stubbe Solgaard & Yang, 2011). In a recent discrete choice experiment conducted in Germany, Bronnmann and Asche (2017) showed that sustainability concerns are reflected in consumers' preferences for ASC-certified compared to non-certified farmed salmon. Risius et al. (2017) conducted a choice experiment among German consumers, focusing on ASC and Naturland labels as well as the country of origin for smoked trout fillets. A significant positive utility was identified for both labels, while the price, the origin and general sustainability claims were found to be more important to consumers than sustainability certification. Based on their literature review of 51 studies on fair trade consumption, Andorfer and Liebe (2012) draw the conclusion that fair trade labels have the potential to influence consumer preferences. Fair trade standards as a specific type of sustainability standards set the focus on improving the livelihoods of smallholders in less developed countries (Andorfer & Liebe, 2012; Grunert et al., 2014). The effects of fair trade labeling in the context of fish products seem to be rather unexplored so far (Jaffry et al., 2004). Resulting from the findings described, a higher probability of choice is expected for pangasius and tilapia fillets with eco-labels or fair trade claims attached, as compared to non-certified alternatives.

The product price as extrinsic information cue might be used by respondents to evaluate the product quality of fish. However, it could also be regarded as a barrier to consuming fish products in general and certified fish products in particular (Andorfer & Liebe, 2012; Brunso, Verbeke, Ottar Olsen, & Fruensgaard Jeppesen, 2009). Assuming price sensitivity, a negative relationship between the price attribute and the probability of choice for pangasius and tilapia was expected. With regard to the fish species, tilapia is so far not well known in Germany and

pangasius tends to be cheaper. It is therefore expected that consumers prefer pangasius over tilapia. Jaffry et al. (2004) found that the brand attribute was not significant for determining purchase decisions for fish. It should therefore be assumed that the brand has no significant impact on the probability of choice for pangasius or tilapia fillets in particular.

Further assumptions are based on psychological concepts that identify knowledge and attitudes as important factors influencing consumer behavior, besides other relevant cognitive aspects (McFadden, 1986; Thøgersen, 2000). Thus, it should be analyzed whether knowledge of certain certification schemes and labels increases the probability to choose certified fish products, based on the assumption that knowledge of sustainability labels is a precondition for raising consumer awareness for this aspect in a purchase situation, which is expected to influence purchase behavior (Thøgersen, 2000). Following up on the study by Grunert et al. (2014), the relationship between concern about sustainability on the one hand and the probability to purchase eco-labeled fish on the other hand should be examined. Although the authors could not identify a clearly positive relationship, this hypothesis should be tested again in the context of this study, as it seems plausible that concerned consumers are willing to take actions in order to reduce their concerns. Table 1 shows an overview of the hypotheses developed for testing. H₁ to H₆ are hypotheses on main effects, while H₇ to H₁₁ are hypotheses on interaction effects.

3. Material and methods

3.1. Discrete choice analysis based on mixed logit models

To test the hypotheses described before, we conducted a discrete choice experiment using an online survey and based the analysis of consumer preferences on the specification of mixed logit models. Discrete choice experiments are based on the behavioral theory of random utility developed by McFadden (1986) based on Thurstone's (1927) law of comparative judgment. In a choice situation, each of the available alternatives is evaluated by the individual consumer in terms of the amount of benefit or utility associated with the respective alternative. It is assumed that the market behavior of an individual follows utility maximization: The consumer chooses the alternative from the set of available alternatives which provides the highest utility for him or her (Adamowicz, Louviere, & Swait, 1998; Louviere, Flynn, & Carson, 2010; McFadden, 1986). According to Lancaster's approach to consumer theory, consumers directly derive utilities from the characteristics of goods (Lancaster, 1966). The overall utility of a certain good is then indirectly derived from the partial utilities – also called part-worth utilities – assigned to the different properties of the good. This utility can be divided into two components: a systematic component which can be observed, and a random component which cannot be observed (Louviere et al., 2010). The systematic utility component can be further specified by distinguishing between the part-worth utilities of the different attributes of the alternative on the one hand and socio-

economic characteristics of the individual influencing choice on the other hand (Adamowicz et al., 1998; McFadden, 1986). Relevant socio-economic characteristics can be integrated in the model through interactions with product attributes. Econometric analysis helps to estimate the choice model in order to obtain reliable values for the importance weight parameters which can be interpreted as marginal utilities (Adamowicz et al., 1998).

Mixed logit models are more flexible than basic logit and probit models because they relax strong assumptions and allow for inclusion of both fixed-effects variables and random-effects variables, depending on the underlying assumptions related to unobserved heterogeneities in preferences. On the downside, mixed logit models are computationally more intensive as they require simulation (Hensher, Rose, & Greene, 2005b, p. 608; Train, 2003, p. 138). Following Train (2003), the probability that respondent *n* chooses alternative *i* among a set of alternatives can be defined as:

$$P_{ni} = \int L_{ni}(\beta) f(\beta) d\beta \quad (1)$$

$L_{ni}(\beta)$ is defined as the logit probability for the parameters β , while $f(\beta)$ is a density function that specifies the weight for the mixed logit probability (Train, 2003, p. 139). For linear choice models, the ratio of any two utility parameters describes the marginal rate of substitution between the two respective attributes, keeping all other relevant factors constant. If one of the two attributes is the product price, the WTP can be expressed in monetary units (Louviere, Hensher, & Swait, 2003, p. 61). The marginal WTP for a certain attribute is the negative of the marginal rate of substitution between the respective attribute and the price attribute, under the assumption that the utility of the price attribute is negative (Hensher, Shore, & Train, 2005a).

3.2. Definition of product attributes and levels

The attribute for the country of origin has been restricted to comprise three relevant countries – Germany, Bangladesh and Vietnam – in order to reduce complexity. Bangladesh is the country in focus of this study, and Vietnam is the most important exporting country of frozen pangasius fillets available in Germany and thus the main competitor for Bangladesh, while tilapia exports from this country are increasing. The inclusion of Germany as COO can be justified, as there are existing RAS systems producing pangasius and tilapia, although they are not yet sold in supermarkets but primarily via direct marketing by producers. Further development of recirculation technologies and opportunities to utilize industrial waste heat from biogas plants may improve the competitiveness of such production systems in the near future (BLE, 2017). Moreover, we are interested in studying ethnocentric tendencies among German consumers and therefore would like to use Germany as COO.

The attribute for sustainability certification was designed with three alternative levels: ASC label, Naturland label, as well as the alternative of no eco-label being attached to the product. Both labels had a

Table 1
Hypotheses on consumer preferences to be tested.

No.	Hypothesis
H ₁	Respondents tend to prefer pangasius over tilapia.
H ₂	The lower the price, the higher the probability that a respondent chooses the product.
H ₃	Respondents tend to prefer pangasius and tilapia from Germany over pangasius and tilapia from Bangladesh and Vietnam.
H ₄	An eco-label increases the probability of choice for pangasius and tilapia.
H ₅	A fair trade claim increases the probability of choice for pangasius and tilapia.
H ₆	The brand of pangasius and tilapia products has no significant impact on the probability of choice.
H ₇	Respondents with a high level of consumer ethnocentrism tend to prefer pangasius and tilapia from their home country (Germany).
H ₈	The better the respondent's country image of a product's COO, the more likely it is that he or she chooses the respective product.
H ₉	Respondents who have a positive perception of aquaculture are less likely to opt out.
H ₁₀	Respondents who know certain standards rather choose certified/labeled products, as compared to respondents who do not know the respective standards.
H ₁₁	Respondents who are more concerned about sustainability issues rather choose certified/labeled products, as compared to respondents who are less concerned.

Table 2
Product attributes and levels tested in the choice experiment.

Product attributes	Attribute levels
Fish species	pangasius tilapia
Price [€/500 g]	2.49 4.49 6.49 8.49 10.49 12.49
Country of origin	Germany Bangladesh Vietnam
Brand	COSTA own brand ("no name")
Sustainability label	ASC Naturland no certification
Fair trade claim	yes no

significant positive effect on purchase decisions in a recent choice experiment with smoked trout fillets in Germany (Risius et al., 2017). A fictitious fair trade claim was added as additional label attribute which could be either attached to a product or not. The fair trade claim was designed as a separate attribute instead of an additional level for the sustainability certification attribute, because fair trade standards predominantly comprise social and ethical aspects and should be distinguished from ASC and Naturland standards, which focus rather on environmental aspects. Among other measures related to decent working and living conditions, Fair trade standards often set a minimum price for exported products is guaranteed to producers (Andorfer & Liebe, 2012).

In order to use realistic attribute levels for the price, preparatory research on existing pangasius and tilapia products offered in different German supermarkets and discounters as well as in web-based shops was conducted in December 2015. These observations confirmed that pangasius products are generally cheaper and more common in Germany than tilapia products. The price range determined in Table 2 is based on real market data for certified and non-certified pangasius and tilapia fillets from different brands. As a rough rule of thumb, organic certification could generally be associated with higher price premiums than non-organic sustainability certification, as compared to non-certified products. Other things being equal, products with fair trade certification are usually also sold at higher prices than non-certified products, and products with both organic and fair trade labels could be expected to be the most expensive. The selected price range from €2.49 to €12.49 per 500 g of frozen pangasius and tilapia fillets accounts for the observed variance due to the different possible combinations of labels and brands. Frozen fish fillets in Germany are sold in packages of different sizes, usually weighing between 250 and 1000 g. The product weight of 500 g was found to be an adequate average weight.

COSTA is a major brand for frozen fish fillets sold in different supermarket chains in Germany. Pangasius and tilapia fillets are also offered by different supermarkets' own brands. Those "no name" brands sell their products typically at lower prices compared to brands COSTA. To study the importance of brands in the context of frozen pangasius and tilapia, COSTA and a not further specified supermarket's own brand ("no name" option) have been defined as available brands.

3.3. Design and implementation of survey and choice experiment

Questionnaires used in previous studies were taken as examples to develop ideas for survey questions applicable to this study (e.g. Brunso et al., 2009; Grunert et al., 2014; Salladarré et al., 2010). The survey including the choice experiment was conducted online using a web-based survey tool. The first part of the questionnaire was comprised of introductory questions about the respondents' fish consumption preferences and purchase behavior. Only those respondents who generally buy fish products to prepare a meal at home were asked to answer questions concerning their purchase behavior.

The software package *Ngene* was used to develop the choice sets for the choice design by combining the attribute levels in a statistically efficient manner. D-efficiency was selected as the relevant design criterion. One important advantage of efficient designs is that they require smaller sample sizes compared to orthogonal designs to achieve the same level of estimation precision (Puckett & Rose, 2010, p. 166). As the design should also be suitable to analyze two-way interaction effects, it was adjusted by using a fold-over command which creates a mirror image of the design to avoid correlation between interaction terms (Louviere et al., 2003, p. 116). The application of the fold-over criterion resulted in a design consisting of 72 choice sets. In order to reduce the number of choice tasks to be completed by each respondent, the design was blocked into nine groups of eight choice sets each. Each of the designed choice sets was then illustrated and an opt-out option was added as third alternative. Without any opt-out option, consumers' preferences might get overestimated due to forced choice between available alternatives in the choice set (Kontoleon & Yabe, 2003).

Fig. 1 shows an example choice set. The opt-out option of the choice sets can be translated as "I do not choose any of these two products", so it can be classified as "no purchase" option. The main advantage of using a "no purchase" option is that the part-worth and overall utilities for not purchasing anything can be assumed to be zero. In contrast, to estimate preferences for a status quo option, further information about the preferred product of each respondent would be required, which

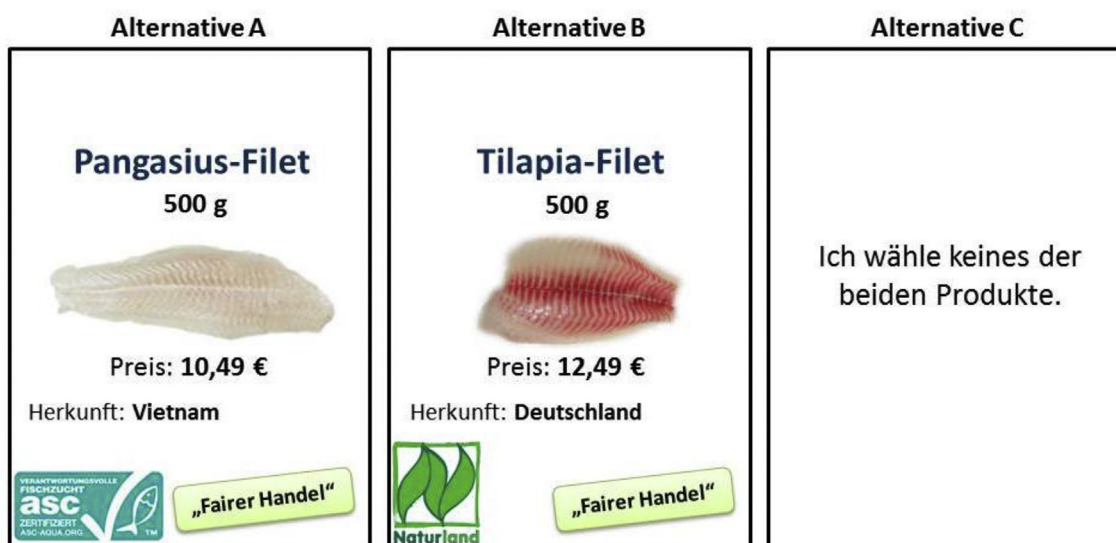


Fig. 1. Example of a discrete choice set.

Table 3
Selected socio-economic characteristics of respondents.

(n = 325)	proportion		proportion
Gender	%	Employment status	%
Female	57.85	currently unemployed	1.23
Male	42.15	student	19.69
Age [years]	%	employed (full-time)	35.69
≤ 20	1.23	employed (part-time)	14.77
21–30	28.92	self-employed	4.92
31–40	10.77	civil servant	16.62
41–50	22.46	retired	3.69
51–60	28.00	other	3.38
> 60	8.62	Household (hh) size	%
Education level	%	1	18.15
Hauptschulabschluss	2.77	2	42.46
Mittlere Reife	16.31	3	20.31
Fachhochschulreife	7.69	4	12.00
Abitur	14.15	≥ 5	7.08
Bachelor's degree	21.54	Monthly net hh income [€]	%
Master's degree	33.85	≤ 1000	8.31
Doctorate	3.69	1001–1500	12.00
		1501–2000	9.85
		2001–2500	11.38
		2501–3000	10.15
		> 3000	36.62
		not specified	11.69

would increase complexity of the questionnaire and the analysis (Kontoleon & Yabe, 2003).

Two choice set blocks of eight choice tasks were randomly assigned to each respondent. The sequence of the choice sets within each block was also randomly ordered to minimize ordering effects. After the choice experiment, the respondents had to evaluate a given set of aspects related to fish products and their production process in terms of relevance for their purchase decision, thereby complementing the open-ended question asked before the choice experiment. Furthermore, the names of different sustainability standards were presented to the respondents in order to obtain a self-assessment of their knowledge of these standards. Respondents could either state that they had never heard of the respective standard before, or indicate that they knew only the name, the appearance of the logo and/or the requirements of the standards. Moreover, respondents were asked to state whether they intentionally purchase fish products certified according to the respective standards. Thus, multiple answers were possible for each of the presented standards.

To find out whether respondents care about environmental and social aspects of sustainability related to food production, potential sustainability-related problems were presented, asking the respondents to indicate to what extent they feel concerned about each of these issues. A set of 14 items developed and applied by Grunert et al. (2014) to measure concern about sustainability issues has been translated into German and used for this purpose. In addition, the participants had to state about which of the presented topics they feel most concerned in the specific context of aquaculture. At the end of this questionnaire section, respondents had to assess different statements related to aquaculture in general and statements with regard to potential obstacles for their consumption of fish products.

To study COO effects, the country image framework developed by Roth and Romeo (1992) has been used as a guideline to develop a customized country image scale, as the original scale did not specify a concrete product category and its four dimensions did not fit well to the research topic of this study. The newly developed scale clearly set the focus on farmed fish. The four sustainability-related dimensions food quality, food safety, social standards and environmental standards of production had to be assessed by the respondents for each of the three countries of origin: Bangladesh, Germany and Vietnam. Afterwards, respondents had to complete a short self-assessment with regard to their ability to evaluate the four dimensions, so that the results for that

section could be more realistically assessed in the analysis phase. In addition, the 10-items CETSCALE developed by Shimp and Sharma (1987) was used in the survey, applying the German translation by Sinkovics (1999) with minor adaptations. The last part of the questionnaire was comprised of questions related to socio-economic characteristics of the respondents.

The online survey was conducted in February 2016. The target group of this exploratory study was not restricted to a specific socio-economic group, besides the general criteria that the respondents should live in Germany, eat fish and in general purchase fish products. Convenience sampling was applied, as for exploratory studies the sample does not necessarily have to be representative of the target population. Different social media were used as distribution channels to address a large audience, but potential participants were also directly approached via e-mail or in person by utilizing personal and professional networks.

4. Results

4.1. Descriptive statistics

Overall, 325 participants completed the online questionnaire. Each of these respondents completed 16 choice tasks. The resulting total number of observations amounts to 15,600. In about 53% of the choice situations, the respondents selected the opt-out alternative instead of one of the two available fish products. 55 out of the 325 respondents chose the opt-out alternative in each of their assigned choice tasks.

4.1.1. Socio-economic characteristics of respondents

Table 3 shows a summary of selected relevant socio-economic characteristics of the respondents. Despite being not representative of the German population, the sample was relatively diverse, comprising people of different age groups, educational levels, employment status and income classes. The age of respondents ranged from 16 years to 81 years, with a mean age of 43 years. Around 59% of the respondents indicated to hold a college or university degree. Responses to questionnaire items dealing with fish consumption and purchase patterns revealed that respondents of the sample prefer fish fillets over alternative forms of preparation. Frozen fish fillets are slightly more often purchased than fresh alternatives. No clear preference between wild caught fish and farmed fish was indicated. The most popular fish species named by respondents were salmon and Alaska pollock. Around 25% of respondents stated that they purchase fish for the preparation of meals at home at least once per week, while 34.5% estimated their purchase frequency at several times per month but less than weekly. The rest of the sample indicated to purchase fish products for meal preparation less often.

4.1.2. Sustainability: knowledge and attitudes

The self-assessment of knowledge about selected sustainability standards revealed that a large fraction of respondents were not familiar with those standards and their criteria. According to the results, the most popular standard was Fairtrade. Nearly all of the respondents indicated to know this standard to some extent, while one third of the respondents stated that they had never heard of ASC before. Only 10% indicated to deliberately purchase ASC-certified products. Naturland as a more general agricultural standard was indicated to be more well-known and also slightly more relevant for purchase decisions, but still nearly one quarter of respondents stated that they had never come across that standard before. Confronted with 14 different sustainability-related problems in the context of food production in general, respondents were asked to evaluate on a 7-point Likert-type scale how concerned they feel about each of them. The mean rating values revealed that respondents are most concerned about food waste, followed by the use of pesticides, animal abuse, and environmental degradation related to food production. Nevertheless, 10.5% of respondents stated

that in the specific context of aquaculture, they are not concerned about any of the sustainability issues presented. In addition, respondents had to indicate how much they agree with six statements – three positively-worded and three negatively-worded items – related to their perception of aquaculture. The average agreement on the negative statements was slightly greater than the respective value for the positive statements, but no clear tendency could be identified for the overall results.

4.1.3. Consumer ethnocentrism and country image

Overall, respondents showed on average a rather low agreement with the statements related to consumer ethnocentrism, with mean values ranging from 1.27 to 3.84 on the 7-point Likert-type scale for the different CETSCALE items. All items were scaled in the same direction, with high scores indicating high agreement with ethnocentric views. The results for the country image scale showed that the respondents' image of Germany was clearly better than that of Bangladesh and Vietnam in all four dimensions related to pangasius and tilapia farming: product quality, food safety, as well as social and environmental standards. A comparison of mean values showed that the difference in rating between Bangladesh and Vietnam was only marginal, with Vietnam achieving slightly better values on all dimensions. However, the self-assessment on how well respondents are able to assess these four dimensions revealed that about one third of all respondents strongly disagreed with the statement that they feel able to judge on those aspects with respect to pangasius and tilapia aquaculture.

4.2. Factor analysis

The fitting of the mixed logit models and the preparatory analyses described below were performed using the statistical software package *Stata 13.0* developed by StataCorp LP. In the first step, a factor analysis was performed to analyze which of the items of the questionnaire might be summarized to factors, thereby also checking the appropriateness of the design of the different scales used in the survey. Sampling adequacy was indicated by the Kaiser-Meyer-Olkin (KMO) measure and scale reliability was measured by Cronbach's alpha (Tavakol & Dennick, 2011).

Factor analysis confirmed one underlying factor for the CETSCALE items to be included in the model for testing hypothesis H_7 on the influence of consumer ethnocentrism. Reverse scoring was applied to the three negatively-keyed items of the six 'attitudes towards aquaculture' statements before conducting a factor analysis. It was hypothesized that the items could be described by one underlying concept, which might be defined as 'positive perceptions of aquaculture'. Factor analysis resulted in two retained factors, one relatively strong factor describing the three positively-worded items and one weaker factor describing the three negatively-worded items. This result might be caused by a so-called method effect related to item wording, leading to the formation of artificial factors, a problem which had also been identified in previous studies (Schriesheim & Eisenbach, 1995). In a second step, the calculations were repeated with only the three positively-keyed items leading to clearly better results. The factor for the three positive aquaculture-related statements was retained for further analysis. Factor analysis for the country image scale resulted in three factors, but it was not possible to identify one distinct factor for each of the three countries. One factor described the country image of Germany. Another factor could be related to product quality and food safety for both Bangladesh and Vietnam, the other factor described social and environmental standards in both countries. Those three factors were kept to test interactions with the different COOs in the choice analysis. For the 14 questionnaire items related to concern about different sustainability issues in the context of food production, the very high value for Cronbach's alpha might partly result from the high number of items, therefore possibly indicating redundancy (Tavakol & Dennick, 2011). The resulting factor was retained for further analysis. Table 4 shows the results of the factor analysis.

4.3. Discrete choice model estimation

Choice is the dependent variable of the model, which was assigned a value of one if the respective product was chosen, and zero otherwise. An alternative-specific constant named *optoutvar* was created in order to estimate the utility of choosing the opt-out option. Following Bech and Gyrd-Hansen (2005), effects-coded variables were created for categorical variables instead of dummy variables in order to avoid potential misinterpretation resulting from the correlation of dummy-coded product attributes' effects with the effect of *optoutvar*. The price attribute was kept as a continuous variable called *Price*. Both the standard Hausman test as well as a cluster-robust modified version (Cameron & Trivedi, 2009, pp. 429 ff.; Kaiser, 2014) showed evidence against the assumption of the independence of irrelevant alternatives (IIA). It was therefore decided to estimate mixed logit models which are not constrained by the IIA assumption, using the Stata *mixlogit* package developed by (Hole, 2007).

4.3.1. Mixed logit model considering only product attributes

For the first mixed logit model estimation, only the effects of product attributes on the choice probability were estimated. All independent variables were assumed to have normally distributed random effects, except for *Price*, which was specified as following a log-normal distribution.¹ Specifying the price as being log-normally distributed implies the assumption that the coefficient shows the same sign for all respondents but may take different values. The model was fitted using 100 Halton draws for the simulation. For the log-normally distributed *Price*, the parameters resulting from the simulation are the mean and standard deviation of the natural logarithm of the respective coefficient. These values have therefore been manually converted and replaced by the mean, median and standard deviation of the actual coefficient (Hole, 2007; Train, 2003). As a certain degree of substitution effect might be expected between sustainability and fair trade labels, we also tested for interaction effects between the respective variables.

According to the results for the 'product attributes only' model shown in Table 5, *Price* has a statistically highly significant ($p < 0.001$) negative coefficient indicating price sensitivity of respondents. The effect-coded categorical variables *Germany*, *Bangladesh*, *Naturland*, *ASC*, and *FairLabel* have highly significant positive coefficients at $p < 0.001$, while the positive coefficient for *Pangasius* is significant at $p < 0.01$. The coefficient of *Brand* is not significant. The properties of effects coding allow for the estimation of all levels of a categorical variable, including the omitted level. The coefficient of the omitted level calculated as the negative of the sum of coefficients associated with the effects-coded levels of the respective variable (Bech & Gyrd-Hansen, 2005). This means that for this model, *Vietnam* has a coefficient of around -0.439 , which is close to the estimate for *Bangladesh*. Both Asian countries of origin have a negative utility for consumers, while no clear preference between the two could be identified. The coefficients estimated for this model show support for the hypotheses related to the main effects of the product attributes (Table 1, H_1 – H_6). The highly significant negative *optoutvar* coefficient means that a distinct negative utility associated with choosing the opt-out option could be identified. Considering the fact that the opt-out rate was quite high, this might be a rather unexpected result. However, the standard deviation of *optoutvar* is relatively large and highly significant, indicating relevant unobserved preference heterogeneity. While the mean utility of choosing the opt-out option is negative, there might be certain socio-economic groups within the sample who assign a positive utility value to the opt-out alternative. For those variables that have a

¹ For comparison, other model specifications have been tested with *Price* specified as having fixed effects or normally distributed random effects. The Aikake information criterion (AIC) and the Bayesian information criterion (BIC) showed the lowest values for the model with log-normally distributed *Price*, indicating a superior model fit.

Table 4
Results of the factor analysis.

scale	Kaiser-Meyer-Olkin (KMO) measure	Cronbach's alpha	retained factors	no. of items
CETSCALE	0.81	0.86	1: consumer ethnocentrism	10
Country image	0.65	0.79	1: country image of Germany	4
		0.90	2: product quality & food safety in Vietnam and Bangladesh	4
		0.91	3: social and environmental standards in Vietnam and Bangladesh	4
Perceptions of aquaculture	0.74	0.88	1: positive perceptions of aquaculture	3
Concern about sustainability of food production	0.93	0.94	1: concern about sustainability of food production	14

Table 5
Results of the two estimated mixed logit models.

Choice	'Product attributes only' model			Final model including additional significant interaction effects		
	Coefficient (Std. Err.)	p-value (t-statistic)	Std. Dev. (Std. Err.)	Coefficient (Std. Err.)	p-value (t-statistic)	Std. Dev. (Std. Err.)
optoutvar	−0.534*** (0.073)	0.000 (−7.35)	1.477*** (0.077)	−0.018 (0.062)	0.769 (−0.29)	1.131*** (0.060)
Price mean	−0.514*** (0.038)	0.000 (−13.66)	1.270*** (0.226)	−1.344*** (0.024)	0.000 (−56.28)	0.327*** (0.021)
Price median	−0.192*** (0.017)	0.000 (−11.29)		−1.306*** (0.021)	0.000 (−61.10)	
Brand	0.037 (0.032)	0.238 (1.18)	−0.023 (0.049)	<i>(excluded because insignificant)</i>		
Pangasius	0.117** (0.045)	0.009 (2.60)	0.571*** (0.053)	0.107* (0.044)	0.015 (2.43)	0.597*** (0.050)
Bangladesh	−0.482*** (0.051)	0.000 (−9.50)	0.074 (0.099)	−0.509*** (0.055)	0.000 (−9.18)	−0.135* (0.068)
Germany	0.921*** (0.065)	0.000 (14.12)	0.791*** (0.073)	0.975*** (0.070)	0.000 (13.84)	0.707*** (0.078)
Naturland	0.418*** (0.055)	0.000 (7.62)	0.624*** (0.064)	0.417*** (0.063)	0.000 (6.58)	0.497*** (0.062)
ASC	0.409*** (0.048)	0.000 (8.54)	−0.147 (0.100)	0.393*** (0.053)	0.000 (7.39)	0.338*** (0.069)
FairLabel	0.339*** (0.034)	0.000 (9.97)	0.114 (0.064)	0.353*** (0.034)	0.000 (10.23)	0.090 (0.054)
Fair*ASC	−0.023 (0.048)	0.630 (−0.48)	0.063 (0.077)	<i>(excluded because insignificant)</i>		
Fair*Naturland	−0.132** (0.050)	0.008 (−2.67)	−0.093 (0.073)	−0.151** (0.046)	0.001 (−3.26)	0.020 (0.071)
country image (quality & safety) for Bangladesh * Bangladesh		CI_QS*Bangladesh		0.326*** (0.062)	0.000 (5.28)	0.176* (0.079)
country image (quality & safety) for Bangladesh * Germany		CI_QS*Germany		−0.338*** (0.065)	0.000 (−5.16)	−0.381*** (0.103)
country image Germany * Germany		CI_Germany*Germany		0.173* (0.078)	0.026 (2.23)	0.194 (0.142)
country image Germany * Bangladesh		CI_Germany*Bangladesh		−0.188** (0.063)	0.003 (−2.97)	−0.102 (0.107)
knowledge about ASC * ASC		ASC_know*ASC		0.120* (0.050)	0.015 (2.43)	0.106 (0.070)
knowledge about Naturland * Naturland		Naturland_know* Naturland		0.198** (0.058)	0.001 (3.39)	0.033 (0.098)
concern about sustainability * optoutvar		concern*optout		0.523*** (0.050)	0.000 (10.39)	0.533*** (0.052)
respondents' age * optoutvar		age*optout		0.022*** (0.003)	0.000 (6.73)	0.047*** (0.004)
perception of aquaculture* optoutvar		aqua*optout		−0.377*** (0.047)	0.000 (−7.97)	0.638*** (0.058)
Model fit:	'Product attributes only' model			Final model including additional significant interaction effects		
	No. of observations: Log likelihood:	15,600–3693		No. of observations: Log likelihood =	15,600–3616	
	LR chi2(11) = 2306	AIC: 7429 BIC: 7598		LR chi2(18) = 2203	AIC: 7304 BIC: 7579	
	Prob > chi2 = 0			Prob > chi2 = 0		

***significant at $p < 0.001$; ** significant at $p < 0.01$; * significant at $p < 0.05$.

significant coefficient with an insignificant standard deviation, it might also be appropriate to specify them as having fixed effects rather than random effects.

The coefficients of the label interaction effects *FairLabel***Naturland* and *FairLabel***ASC* have to be interpreted in the context of the respective

main effects. *FairLabel***ASC* is not significant, indicating that the utility of having both labels can be better described by the sum of the significant main effects, as no relevant complementary or substitution effects could be identified. In contrast, *FairLabel***Naturland* shows a significant negative effect. In practice, this means that there is a

Table 6
Willingness-to-pay estimation for the ‘product attributes only’ model.

WTP (€/500 g)	Pangasius	Germany	Bangladesh	ASC	Naturland	FairLabel	FairLabel* Naturland
mean Price	0.23	1.79	−0.94	0.80	0.81	0.66	−0.26
median Price	0.61	4.80	−2.51	2.13	2.18	1.77	−0.69

relevant substitution effect between the two labels. The joint marginal utility can be calculated as follows (Barreiro-Hurle, Gracia, & De-Magistris, 2010; Heng & Peterson, 2017):

$$\beta_{\text{FairLabel} \& \text{Naturland}} = \beta_{\text{FairLabel}} + \beta_{\text{Naturland}} + \beta_{\text{FairLabel} \& \text{Naturland}} \quad (2)$$

The utility of double certification with *FairLabel* and *Naturland* takes a value of 0.625, which is lower than the sum of marginal utilities considered in isolation. WTP measures can only be calculated for those attributes which have statistically significant coefficients (Hensher et al., 2005b, p. 359). Thus, considering the ‘product attributes only’ model, WTP was estimated for *Pangasius*, *Germany*, *Bangladesh*, *ASC*, *Naturland*, *FairLabel*, and the interaction *FairLabel***Naturland*. Achtnicht (2012) recommends using the median instead of the mean of the price coefficient for WTP estimation in cases in which the log-normal distribution is highly right-skewed. Table 6 shows marginal WTP estimations for the product attributes of 500 g packages of frozen fish fillet for both the mean and median coefficient of *Price*.

The results show that there are large differences in estimated marginal WTP depending on whether mean or median of *Price* are used for the calculation. As an example, the average WTP for 500 g of frozen ASC-certified pangasius fillets from Bangladesh is estimated at only € 0.09 (€ 0.23) for the mean (median) price, which is definitely far too low compared to the price of respective products on the real market.

4.3.2. Mixed logit model with main effects and interaction effects

In order to estimate the expected interaction effects (Table 1, H_7 – H_{11}), additional interaction terms have been created as cross-products of the product attributes and socio-economic factors. The aspect of respondents’ knowledge of the three labels is covered by three effects-coded variables, one for each label, indicating whether or not respondents had stated to know the label. These effects-coded variables have been interacted with the respective label variables. Continuous variables have been means-centered for the models involving interaction terms. The majority of interaction terms did not show significant effects on choice. They were therefore removed step by step while cross-checking the impact on the effect values.

The effects of product attributes which had been significant in the ‘product attributes only’ model were found to be still significant in the final mixed logit model with significant interaction terms shown in Table 5, while only *optoutvar* does not show a significant effect anymore. The coefficient of *Pangasius* is only significant at $p < 0.05$. The interaction terms between the CETSCALE factor and the respective country variables for Germany and Bangladesh were not significant and have therefore not been included in the final model. Hence, the results do not support hypothesis H_7 . However, the country image seems to play a role: A significant positive effect on choice was recognized for the interaction term between the country image factor variable for Germany and the COO variable *Germany*. Vice versa, a significant negative effect was identified for the interaction term between *Bangladesh* and the country image of Germany, meaning that respondents who have a positive image of Germany are less likely to purchase products from Bangladesh. As explained in section 3.2, it was not possible to identify one single underlying factor describing the country image for Bangladesh, so two factors had to be retained, each of them covering two dimensions for Bangladesh and Vietnam combined. The factor variable covering the dimensions of food quality and safety was found to be highly significant. Interacted with *Bangladesh*, it was significantly

positive, while the interaction with *Germany* was significantly negative. However, no significant effects were found for interactions with the factor variable for social and environmental standards, so these interactions were removed from the model. Hypothesis H_8 can therefore only partly be supported by the results.

A highly significant negative effect was found for the interaction between *aqua* and *optoutvar*, suggesting that respondents who tend to have a positive perception of aquaculture are less likely to opt out. Therefore, hypothesis H_9 can be supported. Respondents who indicated to have some prior knowledge about certain Naturland and ASC standards are more likely to purchase fish products with the respective labels attached. This relationship is expressed by the positive effects of the two knowledge-label interactions. The interaction between *FairLabel* and stated knowledge on Fairtrade certification was found to be not significant, which might be attributed to the fact that we did not show the actual Fairtrade label but a generic a fair trade claim. We found support for H_{10} therefore only with respect to ASC and Naturland. The factor variable describing concern about sustainability issues interacted with the three labels did not show any significant effect and was therefore removed. Thus, H_{11} cannot be supported by the data. An interaction created between *concern* and *optoutvar* had a significant effect, though. Furthermore, a significant positive effect of age on the probability to opt out was identified, indicating that older respondents tend to be more likely to choose the opt-out option.

5. Discussion

The overall opt-out rate in the choice experiment was very high (53%), and 17% of the respondents selected the opt-out option in all of their choice tasks. Possible reasons for this behavior are manifold. While one respondent revealed through personal feedback after her participation that she would not at all buy any non-native fish species produced in artificial environments, another respondent indicated that she did know neither tilapia nor pangasius and therefore would be reluctant to eat these species. Answers to survey questions on the respondents’ fish consumption habits showed that pangasius and tilapia can hardly compete with other species like salmon and Alaska pollock in terms of stated preferences among German consumers. Considering socio-economic interaction effects, older respondents were more likely to opt out. One possible explanation might be that with increasing age, people might be less likely to try out food they are not familiar with, and instead rather stick with the fish species they know. Those respondents having less positive perceptions of aquaculture in general were more likely to opt out, which makes sense as only aquaculture products were available for selection. Moreover, respondents who were concerned about sustainability issues were more likely to opt out. One possible interpretation of this finding might be that they associated the production of pangasius and tilapia fillets with adverse effects on sustainability, despite of the availability of sustainability certification in various combinations. These results might be an interesting starting point for further research on specific target groups. Another interesting finding from a comparison of the two fitted models is that the main effect of *optoutvar* becomes insignificant when interaction effects are added. It can therefore be reasoned that the interaction effects mentioned before cover the most relevant socio-economic factors that can be associated with opting out. It would be interesting to further analyze whether there is a relationship between concern about sustainability

and perceptions of aquaculture that might have an effect on choice. The choice design as well as the small sample size did not allow for the analysis of such three-way interactions, though.

The brand of the fish product did not play a relevant role for choice, so using a premium brand to gain market share would probably not be a promising idea. However, this result should be treated with caution, as only one brand, namely COSTA, was included in the choice experiment. It might be the case that other brands are more interesting for consumers. The factor for concern about sustainability did not significantly influence preferences for eco-labeled or fair trade pangasius and tilapia, so there might be a gap between attitude towards sustainability and actual consumption behavior. Another possible interpretation might be that the labels considered did not convince the concerned respondents of the product-related sustainability. But overall, there seems to be a positive utility for sustainability certification according to the ASC and Naturland standards, as well as for fair trade claims. Knowledge of the standards appears to have a positive influence on preferences for fish products with the known sustainability labels attached. Thus, it seems that information and knowledge do indeed matter. [Risius et al. \(2017\)](#) also suggest that recognition of labels and trust in sustainability standards are important determinants for choice decisions.

Germany is clearly preferred as COO compared to both Bangladesh and Vietnam. This result is in line with [Risius et al. \(2017\)](#) who found that German consumers prefer Germany as country of origin over Denmark, Poland and Turkey for smoked trout fillets. While in our study these preferences could not be attributed to consumer ethnocentrism, results indicate that the country image might play a certain role. Respondents who had a rather positive image of food quality and safety in Bangladesh and Vietnam were significantly more likely to choose a fish product from these countries, while they were rather unlikely to choose a product from Germany. Interestingly, respondents seemed to be less interested in social and environmental circumstances of production in the Bangladesh and Vietnam, as no significant interaction effects could be identified. Thus, consumers seem to care more about their own health than about healthy production conditions in the COO. This would be an interesting aspect for further research. Overall, no significant difference in preferences between Bangladesh and Vietnam as COOs could be identified. Consumers might lack knowledge on differences between the two countries, so it is rather difficult for them to make a distinction. While eco-labeling and fair trade labeling overall might increase the probability that consumers purchase pangasius or tilapia from Bangladesh, the estimated WTP is still far too low compared to real market prices. Even if a general demand can be identified for a product sold at a certain price, offering the product at this price has to be financially viable for the actors throughout the supply chain, otherwise a market entry would make little sense. Therefore, also supply side conditions should be analyzed in detail before drawing final conclusions on whether to export pangasius or tilapia from Bangladesh to Germany. Considering the fact that pangasius from Vietnam is already established in the German market, while respondents did not significantly differentiate between Bangladesh and Vietnam, the explanatory power of the low WTP estimates should be critically assessed.

It has to be acknowledged that the results of this study are subject to several limitations. Different types of biases resulting from the design of the choice experiment and the overall questionnaire might have influenced the research results. The so-called hypothetical bias might have distorted the results. Moreover, respondents might tend to select answers according to what they perceive to be socially desirable, causing social desirability bias ([Andorfer & Liebe, 2012; Carlucci et al., 2015](#)). This may have had an impact on the insignificant results for the influence of consumer ethnocentrism. Selection bias might be another problem, as the sample was not representative of the German population and most likely not sufficiently large and diverse to reliably estimate all relevant interaction effects. As the survey was conducted only as a web-based version, certain population groups which are less

familiar with the internet such as older people effectively might have been excluded from the study.

Furthermore, it is realistic to assume that not all relevant factors influencing consumers' preferences and purchase decisions have been considered in the choice design. This aspect is important, as [Gao and Schroeder \(2009\)](#) observed that the WTP for single attributes of food products changed when product information was added in the form of additional attributes. The omission of potentially decision-relevant factors might lead to overestimation of the importance of the variables included in the choice experiment ([Grunert et al., 2014](#)). The form of the opt-out alternative chosen for the choice sets has an impact on estimated parameters of the choice model and the choice shares, and therefore might lead to biased results. It might be the case that in a real world scenario, the respondents would not purchase any of the alternatives of the given choice set, but rather decide for another fish species or for a meat product instead of not purchasing anything at all. Therefore, the WTP for different fish products might be overestimated in a choice experiment, as compared to actual purchase behavior in a real market with a larger variety of available alternatives. Further research should also focus on the preferences for pangasius and tilapia as compared to other fish species which are more common in Germany, such as Alaska pollock. These had not been included as alternatives in this choice experiment.

6. Conclusion

This study adds to previous research by investigating consumer preferences for certain product attributes of frozen pangasius and tilapia fillets in Germany, focusing in particular on the effects of country of origin and sustainability certification. The results show that the respondents generally preferred cheaper products. Significant positive utility values have been estimated for the eco-labels of ASC and Naturland, as well as for a generic fair trade claim. Consumers who indicated to know ASC or Naturland were more likely to choose products certified according to these standards. The estimated partial utility of the brand COSTA was not significant.

With respect to the country of origin, consumers significantly preferred Germany over Bangladesh and Vietnam, but no significant difference in utility between the two Asian countries could be identified. Consumers who have a negative country image of Bangladesh and Vietnam related to perceptions of health and food safety issues are less likely to choose fish products from these countries of origin. The purchase decision was not significantly influenced by the country image factors of social and environmental standards. These results might indicate that egoistic motives, such as concern about personal health, are more relevant in consumers' purchasing decisions. No decision-relevant consumer ethnocentric tendencies have been discovered. Future studies which aim at isolating the effect of sustainability claims in fish marketing could include a treatment that explicitly hints at rigorous border controls for imported products, which should ensure health and safety of all products available for choice.

In more than half of the choice situations, consumers decided not to choose any of the product alternatives offered in the choice experiment. Around 17% of the respondents always opted out in each of their choice tasks. Therefore, despite a trend towards increasing fish consumption, the general market potential of tilapia and pangasius in Germany should not be overestimated, as consumers might rather prefer other species, as indicated in the survey. The analysis of interaction effects revealed that certain socio-economic characteristics like age and the level of education have an impact on the probability to opt out, which might be relevant for marketing decisions and further studies focusing on this aspect. Limitations related to the design of the study need to be considered when interpreting the results. Convenience sampling makes it difficult to draw conclusions for the whole population. Biases attributable to the hypothetical purchase situation might lead to an overestimation of the market potential.

While this study was primarily focused on the demand side of certain aquaculture value chains, supply side conditions are also relevant to consider. Despite the generally positive results for the effects of sustainability certification on choice, it remains open to what extent producers in Bangladesh would benefit from certification and increased fish export, as distributional inequalities are typical within international supply chains in the food sector (Belton et al., 2011). Future research should concentrate on analyzing whether the development of a new market for pangasius and tilapia from Bangladesh in Germany or other European countries could contribute to sustainable development in Bangladesh by enabling small-scale rural farmers in particular to improve their livelihoods, while at the same time improving environmental and social conditions of aquaculture production.

Conflicts of interest

None.

References

- Achtnicht, M. (2012). German car buyers' willingness to pay to reduce CO₂ emissions. *Climatic Change*, 113(3–4), 679–697. <https://doi.org/10.1007/s10584-011-0362-8>.
- Adamowicz, W., Louviere, J., & Swait, J. (1998). *Introduction to attribute-based stated choice methods*. Final report to resource valuation branch, damage assessment center Washington, USA: NOAA, U.S. Department of Commerce. NOAA-National Oceanic Atmospheric Administration. Retrieved from <http://citeseer.ist.psu.edu/viewdoc/summary?doi=10.1.1.119.6910> December 10, 2015.
- Ali, H., Haque, M. M., & Belton, B. (2013). Striped catfish (Pangasianodon hypophthalmus, Sauvage, 1878) aquaculture in Bangladesh: An overview. *Aquaculture Research*, 44(6), 950–965. <https://doi.org/10.1111/j.1365-2109.2012.03101.x>.
- Andorfer, V. A., & Liebe, U. (2012). Research on fair trade consumption - a review. *Journal of Business Ethics*, 106(4), 415–435. <https://doi.org/10.1007/s10551-011-1008-5>.
- Anka, I. Z., Faruk, M. A. R., Hasan, M. M., & Azad, M. A. K. (2013). Environmental issues of emerging pangas (Pangasianodon hypophthalmus) farming in Bangladesh. *Progressive Agriculture*, 24(1–2), 159–170. <https://dx.doi.org/10.3329/pa.v24i1-2.19118>.
- ASC (Aquaculture Stewardship Council) (2012a). *ASC pangasius standard (version 1.0)*. Retrieved from http://www.asc-aqua.org/upload/ASC%20Pangasius%20Standard_v1.0.pdf November 15, 2015.
- ASC (Aquaculture Stewardship Council) (2012b). *ASC Tilapia standard (version 1.0)*. Retrieved from http://www.asc-aqua.org/upload/ASC%20Tilapia%20Standard_v1.0.pdf November 15, 2015.
- Badiola, M., Mendiola, D., & Bostock, J. (2012). Recirculating Aquaculture Systems (RAS) analysis: Main issues on management and future challenges. *Aquacultural Engineering*, 51, 26–35. <https://doi.org/10.1016/j.aquaeng.2012.07.004>.
- Balabanis, G., & Diamantopoulos, A. (2004). Domestic country bias, country-of-origin effects, and consumer ethnocentrism: A multidimensional unfolding approach. *Journal of the Academy of Marketing Science*, 32(1), 80–95. <https://doi.org/10.1177/0092070303257644>.
- Barreiro-Hurle, J., Gracia, A., & De-Magistris, T. (2010). The effects of multiple health and nutrition labels on consumer food choices. *Journal of Agricultural Economics*, 61(2), 426–443. <https://doi.org/10.1111/j.1477-9552.2010.00247.x>.
- Bech, M., & Gyrd-Hansen, D. (2005). Effects coding in discrete choice experiments. *Health Economics*, 14(10), 1079–1083. <https://doi.org/10.1002/hec.984>.
- Belton, B., Haque, M. M., Little, D. C., & Sinh, L. X. (2011). Certifying catfish in Vietnam and Bangladesh: Who will make the grade and will it matter? *Food Policy*, 36(2), 289–299. <https://doi.org/10.1016/j.foodpol.2010.11.027>.
- Björndal, T., Child, A., & Lem, A. (Eds.). (2014). *Value chain dynamics and the small-scale sector - policy recommendations for small-scale fisheries and aquaculture trade*. FAO Fisheries and Aquaculture Technical Paper No. 581 Rome: FAO. Retrieved from <http://www.fao.org/3/a-i3630e.pdf>.
- BLE (Bundesanstalt für Landwirtschaft und Ernährung) (2017). *Perspektiven für die deutsche Aquakultur im internationalen Wettbewerb*. Retrieved from https://www.ble.de/SharedDocs/Downloads/DE/Projektförderung/Innovationen/PerspektivstudieAquakultur-lang.pdf?__blob=publicationFile&v=2 March 6, 2018.
- Brämkick, U. (2015). *Jahresbericht zur Deutschen Binnenfischerei und Binnenaquakultur 2014*. Potsdam: Institut für Binnenfischerei e.V. Potsdam-Sacrow. Retrieved from <http://www.ifb-potsdam.de/de-de/ver/C3%B6ffentlichungen/downloads.aspx> April 5, 2016.
- Bronnmann, J., & Asche, F. (2017). Sustainable seafood from aquaculture and wild Fisheries: Insights from a discrete choice experiment in Germany. *Ecological Economics*, 142, 113–119. <https://doi.org/10.1016/j.ecolecon.2017.06.005>.
- Brunson, K., Verbeke, W., Ottar Olsen, S., & Fruensgaard Jeppesen, L. (2009). Motives, barriers and quality evaluation in fish consumption situations: Exploring and comparing heavy and light users in Spain and Belgium. *British Food Journal*, 111(7), 699–716. <https://doi.org/10.1108/00070700910972387>.
- Bush, S. R., Belton, B., Hall, D., Vandergest, P., Murray, F. J., Ponte, S., et al. (2013). Certify sustainable aquaculture? *Science*, 341, 1067–1068. <https://doi.org/10.1126/science.1237314>.
- Cameron, A. C., & Trivedi, P. K. (2009). *Microeconomics using Stata*. Texas: Stata Press.
- Carlucci, D., Nocella, G., De Devitis, B., Viscicchia, R., Bimbo, F., & Nardone, G. (2015). Consumer purchasing behaviour towards fish and seafood products. Patterns and insights from a sample of international studies. *Appetite*, 84, 212–227. <https://doi.org/10.1016/j.appet.2014.10.008>.
- Claret, A., Guerrero, L., Aguirre, E., Rincón, L., Hernández, M. D., Martínez, I., et al. (2012). Consumer preferences for sea fish using conjoint analysis: Exploratory study of the importance of country of origin, obtaining method, storage conditions and purchasing price. *Food Quality and Preference*, 26(2), 259–266. <https://doi.org/10.1016/j.foodqual.2012.05.006>.
- Evanschitzky, H., Wangenheim, F. V., Woisetschlager, D., & Blut, M. (2008). Consumer ethnocentrism in the German market. *International Marketing Review*, 25(1), 7–32. <https://doi.org/10.1108/02651330810851863>.
- FAO (2016). *State of world fisheries and aquaculture 2016. Contributing to food security and nutrition for all*. Rome: Food and Agriculture Organization of the United Nations (FAO). Retrieved from <http://www.fao.org/3/a-i5555e.pdf> November 3, 2017.
- Gao, Z., & Schroeder, T. C. (2009). Effects of label information on consumer willingness-to-pay for food attributes. *American Journal of Agricultural Economics*, 91(3), 795–809. <https://doi.org/10.1111/j.1467-8276.2009.01259.x>.
- Grunert, K. G., Hieke, S., & Wills, J. (2014). Sustainability labels on food products: Consumer motivation, understanding and use. *Food Policy*, 44, 177–189. <https://doi.org/10.1016/j.foodpol.2013.12.001>.
- Heng, Y., & Peterson, H. H. (2017). Interaction effects among labeled attributes for eggs in the United States. *Journal of International Food & Agribusiness Marketing*, 1–15. <https://doi.org/10.1080/08974438.2017.1413610>.
- Hensher, D. A., Rose, J. M., & Greene, W. H. (2005b). *Applied choice analysis: A primer*. Cambridge: Cambridge University Press.
- Hensher, D., Shore, N., & Train, K. (2005a). Households' willingness to pay for water service attributes. *Environmental and Resource Economics*, 32(4), 509–531. <https://doi.org/10.1007/s10640-005-7686-7>.
- Hernandez, R., Belton, B., Reardon, T., Hu, C., Zhang, X., & Ahmed, A. (2018). The “quiet revolution” in the aquaculture value chain in Bangladesh. *Aquaculture*. (in press) <https://doi.org/10.1016/j.aquaculture.2017.06.006>.
- Hole, A. R. (2007). Fitting mixed logit models using maximum simulated likelihood. *STATA Journal*, 7(3), 388–401. Retrieved from <http://www.stata-journal.com/article.html?article=st0133> February 16, 2016.
- Jaffry, S., Pickering, H., Ghulam, Y., Whitmarsh, D., & Wattage, P. (2004). Consumer choices for quality and sustainability labelled seafood products in the UK. *Food Policy*, 29(3), 215–228. <https://doi.org/10.1016/j.foodpol.2004.04.001>.
- Jiménez-Guerrero, J. F., Gázquez-Abad, J. C., & Linares-Agüera, E. d. C. (2014). Using standard CETSCALE and other adapted versions of the scale for measuring consumers' ethnocentric tendencies: An analysis of dimensionality. *Business Research Quarterly*, 17(3), 174–190. <https://doi.org/10.1016/j.cede.2013.06.003>.
- Kaiser, B. (2014). *RHAUSMAN: Stata module to perform a (cluster-) robust Hausman test*. Bern: University of Bern.
- Kontoleon, A., & Yabe, M. (2003). Assessing the impacts of alternative 'opt-out' formats in choice experiment studies: Consumer preferences for genetically modified content and production information in food. *Journal of Agricultural Policy and Resources*, 5(1), 1–43.
- Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of Political Economy*, 74(2), 132–157.
- Lawley, M., Birch, D., & Hamblin, D. (2012). An exploratory study into the role and interplay of intrinsic and extrinsic cues in Australian consumers' evaluations of fish. *Australasian Marketing Journal*, 20(4), 260–267. <https://doi.org/10.1016/j.ausmj.2012.05.014>.
- Little, D. C., Bush, S. R., Belton, B., Phuong, N. T., Young, J. A., & Murray, F. J. (2012). Whitefish wars: Pangasius, politics and consumer confusion in Europe. *Marine Policy*, 36(3), 738–745. <https://doi.org/10.1016/j.marpol.2011.10.006>.
- Loureiro, M. L., & Umberger, W. J. (2003). Estimating consumer willingness to pay for country-of-origin labeling. *Journal of Agricultural and Resource Economics*, 28(2), 287–301. <https://doi.org/10.1111/j.1574-0862.2010.00466.x>.
- Louviere, J. J., Flynn, T. N., & Carson, R. T. (2010). Discrete choice experiments are not conjoint analysis. *Journal of Choice Modelling*, 3(3), 57–72. [https://doi.org/10.1016/S1575-5345\(13\)70014-9](https://doi.org/10.1016/S1575-5345(13)70014-9).
- Louviere, J. J., Hensher, D. A., & Swait, J. D. (2003). *Stated choice methods: Analysis and applications*. Cambridge: Cambridge University Press.
- McFadden, D. (1986). The choice theory approach to market research. *Marketing Science*, 5(4), 275–297. <https://doi.org/10.1287/mksc.5.4.275>.
- Naturland (2017). *Naturland standards for organic aquaculture - version 05/2017*. Retrieved from https://www.naturland.de/images/UK/Naturland/Naturland_Standards/StandardsProducers/Naturland-StandardsAquaculture.pdf November 3, 2017.
- Parke, G., Young, J. A., Walmsley, S. F., Abel, R., Harman, J., Horvat, P., et al. (2010). Behind the signs - a global review of fish sustainability information schemes. *Reviews in Fisheries Science*, 18(4), 344–356. <https://doi.org/10.1080/10641262.2010.516374>.
- Phuong, N. T., & Oanh, D. T. H. (2010). Striped catfish aquaculture in Vietnam: A decade of unprecedented development. In S. S. De Silva, & F. B. Davy (Eds.). *Success stories in asian aquaculture* (pp. 131–147). Dordrecht: Springer Science+Business Media B. V.
- Prein, M., & Scholz, U. (2014). The role of VSS in enhancing the contribution of fisheries and aquaculture to sustainable development. In C. Schmitz-Hoffmann, M. Schmidt, B. Hansmann, & D. Palekhov (Eds.). *Voluntary Standard Systems - a contribution to sustainable development* (pp. 315–343). Berlin, Heidelberg: Springer-Verlag.
- Puckett, S. M., & Rose, J. M. (2010). Observed efficiency of a D-optimal design in an interactive agency choice experiment. In S. Hess, & A. Daly (Eds.). *Choice Modelling: The state-of-the-art and the state-of-practice* (pp. 163–193). Bingley: Emerald Group Publishing Limited.

- Risius, A., Janssen, M., & Hamm, U. (2017). Consumer preferences for sustainable aquaculture products: Evidence from in-depth interviews, think aloud protocols and choice experiments. *Appetite*, 113, 246–254. <https://doi.org/10.1016/j.appet.2017.02.021>.
- Roth, M. S., & Romeo, J. B. (1992). Matching product category and country image perceptions: A framework for managing country-of-origin effects. *Journal of International Business Studies*, 23(3), 477–497. <https://doi.org/10.1057/palgrave.rm.8250002>.
- Salladarré, F., Guillotreau, P., Perraudeau, Y., & Monfort, M.-C. (2010). The demand for seafood eco-labels in France. *Journal of Agricultural & Food Industrial Organization*, 8(1), Article 10 <https://doi.org/10.2202/1542-0485.1308>.
- Schriesheim, C. A., & Eisenbach, R. J. (1995). An exploratory and confirmatory factor-analytic investigation of item wording effects on the obtained factor structures of survey questionnaire measures. *Journal of Management*, 21(6), 1177–1193. [https://doi.org/10.1016/0149-2063\(95\)90028-4](https://doi.org/10.1016/0149-2063(95)90028-4).
- Shimp, T. A., & Sharma, S. (1987). Consumer ethnocentrism: Construction and validation of the CETSCALE. *Journal of Marketing Research*, 280–289. <https://doi.org/10.2307/3151638>.
- Sinkovics, R. (1999). *Ethnozentrismus und Konsumentenverhalten*. Wiesbaden: Deutscher Universitätsverlag.
- Stubbe Solgaard, H., & Yang, Y. (2011). Consumers' perception of farmed fish and willingness to pay for fish welfare. *British Food Journal*, 113(8), 997–1010. <https://doi.org/10.1108/00070701111153751>.
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53–55. <https://doi.org/10.5116/ijme.4dfb.8dfd>.
- Thøgersen, J. (2000). Psychological determinants of paying attention to eco-labels in purchase decisions: Model development and multinational validation. *Journal of Consumer Policy*, 23(3), 285–313. <https://doi.org/10.1023/A:1007122319675>.
- Thurstone, L. L. (1927). A law of comparative judgment. *Psychological Review*, 34(4), 273–286. <https://doi.org/10.1037/h0070288>.
- Train, K. (2003). *Discrete choice methods with simulation*. Cambridge: Cambridge University Press.
- Verbeke, W., & Roosen, J. (2009). Market differentiation potential of country-of-origin, quality and traceability labeling. *The Estey Centre Journal of International Law and Trade Policy*, 10(1), 20–35.
- Washington, S., & Ababouch, L. (2011). *Private standards and certification in fisheries and aquaculture: Current practice and emerging issues*. FAO Fisheries and Aquaculture Technical Paper No. 553. Rome: FAO. Retrieved from <http://www.fao.org/docrep/013/i1948e/i1948e00.htm> November 30, 2015 .