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Creating markets for under-utilised fish species: Consumer valuation of a co-created fish finger

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ABSTRACT

It is common practice to discarded under-utilised fish species that are caught as bycatch because of their low market value. In this paper, we examine whether locally co-created and produced fish fingers, made from locally sourced under-utilised fish species are valued by consumers by employing a discrete choice experiment (DCE). A novel feature of this study is that we consider three versions of the fish finger, sourced from three UK ports: Plymouth, Lowestoft and Grimsby. Our DCE employs a novel set of attributes to capture the unique characteristics of product design and development of the fish finger. Results reveal that all attributes are positively valued, with the largest for fish that are sustainably caught. We also find that distance to the product locality does not materially affected consumer valuation. Location comparisons indicate limited differences overall for the three versions of the fish finger. These results indicate that sustainability information is a primary driver of demand for processed seafood using species with historically low market uptake, while local cues add value without substituting for sustainability. Our findings can help inform efforts to reduce discarding of under-utilised fish species that remains a significant issue in many fisheries.

1. Introduction

Building a sustainable food system, in part, requires improving fisheries management. However, a share of the catch is bycatch, that is non-targeted catch that ends up in the nets, part of which is under-used (low value edible fish) with the remainder being discarded. Cooney et al. (2023) report that globally between 7 and 10 million tonnes of fish are discarded annually. Roda et al. (2019) and Gilman et al. (2020) estimate that around 10% of the global marine catch is discarded each year. There are negative environmental impacts that result from these practices such as increasing vulnerability of some species as well as ecosystem impacts resulting from damaged habitats (Beukhof et al., 2026). Species that are not vulnerable and are legally edible could be retained, but their low economic value often leads fishers to keep only high-value species and release low-value ones, even though release can involve physical injuries and high post-release mortality. To minimise harm, governments have introduced measures such as quotas, management of fishing areas, and landing obligations which can ban discarding to encourage more selective fishing and better use

of catches. However, Prollezo and Villasante (2023), note that landing obligations have generally been ineffective.

There is evidence that consumers are willing to pay a premium for seafood with lower bycatch levels and that poor fishing practices can negatively affect purchase intentions, though the strength of these effects varies by species and market context (Asche & Bronnmann, 2017; Tanner et al., 2021; Xhakollari et al., 2025). In addition, there is empirical research indicating that consumers place greater trust and favour goods that are produced and sourced locally (e.g., Budhathoki et al., 2025; Cantillo et al., 2020; Hammarlund et al., 2025; Jaffry et al., 2004). This evidence, suggests that there could be unrealised economic returns for the fishing industry by reconsidering how they manage and use bycatch, as well as supply produce that is local and sustainably caught. At the same time, it needs to be understood that consumers differ considerably in terms of how much and what type of fish they buy. For example, Armbrrecht et al. (2023) reports that Swedish consumers reveal very heterogeneous preferences regarding the consumption of fish that presents a real challenge for changing buying behaviour.

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¹ See: <https://www.plymouth.ac.uk/research/institutes/sustainable-earth/healthy-landscapes/foodsequal-plymouth>.

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In the UK, a recent research project¹ has examined the potential for using under-utilised fish species that would typically be classified as bycatch to produce a local food product: The Plymouth Fish Finger (PFF) (Hunt et al., 2026). The PFF is the result of a locally designed and produced food collaboration (i.e., co-creation) between community food researchers, school children and various industry partners aiming to create a food product that is healthy and sustainable. The co-creation of the PFF can be understood with reference to Arnstein's Ladder of Participation (Arnstein, 1969) in terms of the relationship between the groups involved (i.e., co-design and co-production) as well as the level of engagement and community education. The focus on co-creation is an emerging strategy in terms of food development (Durco et al., 2025; Nnadiogbulam et al., 2025; Ribeiro et al., 2025; Shaw et al., 2024). In particular, like the PFF project, there are examples of new product co-creation that involve specific segments of the population. Domingie et al. (2025) report on co-creation of protein-rich appetisers involving older adults, whereas Velázquez et al. (2022) consider healthy dairy products aimed at school children. There are also examples of co-development of production technologies in fisheries to address issues of sustainable management (Mozumder & Schneider, 2026).

In this paper, we examine the extent to which a locally produced co-created food product is valued by consumers. To do this, we have developed a hypothetical discrete choice experiment (DCE) using the PFF. Our DCE employs the following product attributes: locally caught; locally produced; co-created with local communities; sustainably caught; and under-utilised (non-discarded bycatch) species. By employing this set of attributes our research differs from the existing DCE literature examining consumer preferences regarding fish products (e.g., Asche & Bronnmann, 2017; Tanner et al., 2021; Xhakollari et al., 2025). In particular, we are interested to understand the extent to which sustainably caught under-utilised fish species that have been used to co-create a new food product is valued by consumers. Our DCE was also designed to assess the extent to which the name given to the product influenced choice. To examine this characteristic, our DCE was replicated across three locations (i.e., Plymouth, Grimsby and Lowestoft) with each having its own named fish finger i.e., PFF, Grimsby Fish Finger (GFF), Lowestoft Fish Finger (LFF). We selected Grimsby and Lowestoft as the alternative geographic locations given their historical association with fishing. Grimsby is still an active fishing port whereas Lowestoft is no longer operational. We made this choice to assess if geographic location and historical industry association has as an influence on value.

This research contributes to the literature in three ways. First, our DCE is novel in terms of the set of attributes we employ, specifically the inclusion of co-creation. As noted, there is growing interest in co-creation in the development of new food products and it is clearly a characteristic that could be leveraged on in terms of marketing. Second, by replicating the experiment for three local fish fingers (i.e., PFF, GFF, and LFF), we can assess the extent to which a specific geographic location and the associated identity with fishing influences preferences. Finally, our analysis contributes to the literature on the application of stated preference research to fisheries management and consumer attitudes to bycatch.

Our results indicate that respondents highly value fish that are caught sustainably regardless of product location. In contrast, even though co-creation attribute is positively valued it is the lowest for all three fish fingers. We also find little variation in our DCE attribute willingness-to-pay (WTP) estimates by product location. We discuss the significance of our findings in terms of future product development and marketing implications.

The structure of the paper is as follows. Section 2 briefly reviews the antecedent literature, with a focus on DCE studies and the attributes employed. Section 3 then introduces the DCE and its design and Section 4 outlines our econometric model. Next, we present our findings. and in Section 6, we discuss the implications. Finally, in Section 7 we conclude.

2. Literature review

We first examine the way in which co-creation is rooted within the broader literature on participatory food systems, consumer trust, procedural value, social legitimacy and ethical consumption. We then review the antecedent literature on consumer preferences for fish and seafood with a specific focus on stated preference DCE.

2.1. Co-creation and food systems

Food systems present persistent injustices, including unequal access to healthy and affordable food plus the disproportionate burdens borne by marginalised communities. The principle of justice has emerged as a potential guide for any transformative agenda for food system change (Parzonko et al., 2025). Scholars have called for more participatory governance processes grounded in inclusion, transparency, empowerment and fairness treatment. These demands are closely connected to concerns of procedural justice, which focuses on the fairness and inclusivity of decision-making processes themselves rather than solely on the distribution of their outcomes. Alternative food networks and participatory practices such as co-creating knowledge and/or products, shared responsibilities and creating space for deliberation, have been identified as a contributors to transitions in food systems (Huttunen, Ojanen, et al., 2022). Participatory food systems have been modelled and tested, engaging stakeholders who bring diverse perspectives and interests to transformative processes. Potential benefits have been observed, such as improved food security and economic support for rural communities and poor, vulnerable populations.

The PFF project was co-designed and co-created in accordance with this approach, integrating diverse local fish stakeholders, schools and community participants in their product development (Hunt et al., 2026). They followed a participatory food system modelling framework to map the systems to develop the best product by working together (Pettinger et al., 2026). In so doing, the PFF project contributes to the agenda addressing transformative and just food system (Rockström et al., 2025). Furthermore, Pettinger et al. (2026) call for the need for greater “social innovation” if the transformation is to be meaningful, “new strategies, practices, organisational designs and collaborations that address unmet social needs and failures of state and market-led provision. As a multistakeholder process and mode of governance, social innovation aims to be more inclusive, participatory and attuned to social wellbeing concerns compared to innovation that is primarily motivated by private profit.” (p.3).

For co-creation to play a meaningful role in transforming the food system, it must also be guided by appropriate procedural values, generally defined as a code of conduct that include practices such as equality, honesty, integrity and openness (De Graaf & Paanakker, 2015). Closely tied to this is the concept of social legitimacy, a generalised perception that an entity's actions are desirable, proper or appropriate within a socially constructed system of norms, values and beliefs (Suchman, 1995). Social legitimacy can be ensured only by consulting society's members, and therefore it must be anchored in procedural values. In food systems, deliberative and participatory practices hold promise for improved trust and legitimacy alongside increased knowledge and empowerment of participants (Huttunen, Turunen, & Kaljonen, 2022).

Co-creation can also be situated within the literature on ethical consumption, a domain of consumer research concerned with the ethical considerations individuals bring to their consumption decisions. Ethical consumption describes the deliberate modification of consumption practices to mitigate their social and environmental consequences, from everyday purchasing decisions to the reduction of unsustainable consumption altogether (Arman & Mark-Herbert, 2024).

Finally, it can be argued that co-creation can increase consumer trust in food systems, and positively affect how information and food are perceived, by reducing information asymmetry and strengthening reliance on producers, retailers and the wider food system. This may be particularly important when a food system becomes increasingly

reliant on credence attributes which cannot be verified by consumers, including provenance, production methods and ethical standards, but are valued by consumers. Macready et al. (2020) argue that trust in the food chain should be conceptualised, measured and monitored, as consumer confidence is largely determined by beliefs about the trustworthiness of food chain actors and is expected, in turn, to shape demand for products with credence characteristics such as sustainability. Understanding and maintaining consumer trust is thus central to planning future sustainable food systems and to the effectiveness of food policy. Empirical research consistently indicates that consumers favour goods that are produced and sourced locally (e.g., Budhathoki et al., 2025; Cantillo et al., 2020; Hammarlund et al., 2025; Jaffry et al., 2004). These consumer preferences have been linked to trust: consumers' perceptions of local food are shaped by confidence in its origin and production, and direct interaction between producers and consumers has been shown to reinforce trust in food quality and safety, with trust acting as a direct antecedent of purchase intention (Giampietri et al., 2018).

2.2. DCEs and seafood

The literature examining consumers preferences regarding fish and seafood is large. Recent reviews consolidate the evidence on product attributes, research methods, and the impact of information and food labels on consumer choice. For example, Cantillo et al. (2020) present a systematic review of DCEs from 2000 to 2019. They report that origin is the most commonly used attribute, followed by the harvest method, the types of certification, and species. Reported WTP indicate consumer positively value domestic products, wild over farmed, and certified items with positive premia for labels. However, this review provides little detail on econometric methods or experimental design that are important in understanding DCE findings. Saidi et al. (2023) also provides a systematic review of consumer-preference studies between 2015 and 2022 using the PRISMA framework. They note that origin, production method and certification recur most often, with generally positive WTP for certified products and that many consumers are confused by fish labels and do not fully understand the information provided.

Meta-analytic evidence further confirms that consumers are generally willing to pay a premium for sustainable seafood, though the magnitude varies considerably across markets, species, and sustainability attributes (Lokugamage et al., 2024). More broadly, the literature identifies cost as the most commonly reported barrier to seafood consumption, followed by sensory barriers, health beliefs, habits, availability and cooking skills (Govzman et al., 2021).

2.2.1. Seafood and bycatch

A number of DCE studies have examined consumer attitudes to seafood and bycatch. Bronnmann and Asche (2017) ran three independent DCE with German seafood consumers using frozen cod fillets as the product employing five attributes including bycatch. They report that higher levels of bycatch and over fished stocks result in a reduce probability of purchase. Tanner et al. (2021) consider the Galapagos Marine Reserve and the design of a product-certification scheme intended to protect the environment and support artisanal fishers. Their DCE employed five attributes including bycatch, which they defined as non-target animals incidentally caught while fishing for yellow fin, typically sharks, sea turtles, seabirds, and non-target fishes, whether retained or discarded. Tanner et al. (2021) report that tourists value low bycatch and are WTP for this improved management outcome. Natali et al. (2022) examine bycatch noting that information and awareness increase WTP and willingness-to-choose white shrimps, highlighting a potential market for bycatch products. Finally, Boncinelli et al. (2025) examine consumer preferences for low-market-value fish that are not commonly purchased due to perceptions around preparation and associated cooking skills. This DCE was implemented in a restaurant setting. Unlike many other studies they report that framing under-utilised fish species within a cooking tradition generated a stronger positive response than simply appealing to sustainability of the resource.

2.2.2. Product type

There have been a limited number of studies that have examined seafood products. For example, Boughanmi et al. (2007) estimated consumers' preferences and value-added of read-to-eat fish products in Oman using conjoint analysis. They found that a product finger format carries a premium, with cooking method the most important attribute. Paci et al. (2018) investigated consumer preferences for fish burgers in southern Italy using a DCE employing five attributes: fish type (often species with many bones), type of oil, a health attribute, an environmental attribute, and price. They report that respondents valued environmental aspects of fishing and health attributes. More recently, Xhakollari et al. (2025) conducted a DCE examining three products, including a seafood burger, focusing on eco-labelling attributes (i.e., over fishing, bycatch, carbon footprint) and shelf life. They found that higher environmental awareness is associated with stronger preferences for eco-labelled options and higher WTP, consistent with prior literature. Reported preferences for local products were linked to perceptions of greater environmental friendliness and higher quality.

Another complicating factor regarding product type, is the context in which food choices are made is changing, with a growing share of food purchased online. Evidence presented by Caputo (2025) suggests that the resulting choices are often poor in dietary terms, nutritionally unbalanced and falling short of healthy eating goals. These patterns in the data indicate that healthy seafood options are not being selected frequently. Moreover, although healthy and sustainable options are increasingly available as food away from home, their affordability remains the central barrier, reinforcing existing inequalities in food choice and the dietary differences associated with them (Caputo, 2025).

2.2.3. Product labels and sustainability

The impact of different types of product label has been examined extensively using both revealed and state preference methods. Employing hedonic price models, Asche and Bronnmann (2017) present a study based on German retail scanner data from 2008 to 2010, covering frozen fillets of three fish types. They found that the effect of eco-labels is not uniform and is species dependent, and that processing fish reduces price relative to natural fillets. They identify price premiums for eco-labels (Roheim et al., 2011) with consumers preferring fish and seafood harvested in a sustainable way. In addition to eco-labels, origin and mode of production have important effects on consumer preferences (Jaffry et al., 2004). Based on these earlier findings, Sogn-Grundvåg et al. (2025) used the hedonic price model to look at value creation along the supply chain for haddock. They report that if the price premium associated with sustainable fishing practices is transmitted through the supply chain, it positively influences socially and economically sustainable practices.

In Vietnam, Xuan (2021) examined preferences for eco-labelled shrimp employing a DCE. Results show that eco-labels increase the probability of purchase and generate a positive WTP relative to conventional shrimp. Using the same data, Xuan et al. (2025) reporting that Vietnamese consumers have a positive demand for farmed shrimp and prefer sustainably labelled farmed shrimp to unlabelled shrimp.

These findings are consistent with the broader evidence: a recent meta-analysis indicates that a sustainability label can generate an increase in willingness to pay of around 30% (Andreani et al., 2026). However, McCluskey and Hyink (2026) observe that although many consumers will pay a premium for sustainability claims, they frequently conflate health and environmental attributes. For example, the omega-3 content of fish and the method by which it was caught are conflated, raising questions about the credibility of such claims and effective label design.

Labels also co-exist with other cues used by consumers and they interact in meaningful ways. For example, origin and sensory information affect consumer preferences (Budhathoki et al., 2025). Also, preparation and freshness labels guide expectations at the point of

purchase (Kamiyama et al., 2024). Schrobback et al. (2025) examine seafood preferences with a best-worst scaling method across 12 countries. Unsurprisingly, findings reveal a global interest for food safety and taste, followed by sustainability attributes that relate to environment and health. Finally, Hammarlund et al. (2025) report that consumers generally view certified farmed products favourably, but price effects are mixed and often smaller than effects from other cues such as geographical origin.

2.2.4. Fishing context

Beyond individual products, several DCE studies value the cultural setting in which seafood is produced and sold. Durán et al. (2015) examined the economic value of social sustainability, focusing on the conservation of maritime cultural heritage. Using a DCE in Galicia with examining tangible and intangible heritage they find that all heritage attributes increased utility relative to the status quo. The highest WTP was for fishing architecture, followed by fishermen's knowledge. Martino et al. (2023) also use a DCE in two Scottish coastal towns, the value placed on cultural and heritage aspects in seafood choices with a design that included origin, processing, harvesting, environmental certification, consumption setting, and heritage visibility attribute. They find that all non-monetary attributes increase utility, with origin and certification most influential, arguing that Maritime Cultural Heritage such as tangible (buildings, museum, docks) and intangible traditions (festival, food and drink testing, etc.) are important. WTP for the heritage attribute is positive for locals but not for visitors. The study shows that the links between seafood and locality, sustainability, and visible fishing activity are important to consumers and can inform place-based policy.

3. Experimental design and data

3.1. DCE design

3.1.1. Selection of attributes and levels

Our experimental went through several rounds of development. First, we considered the antecedent literature with a specific focus on DCE studies examining fish and fish-based products. Second, we presented our initial set of potential attributes to our project partners (Footnote: Details provide when manuscript is accepted for publication). Importantly, the composition of project partners included local community groups (i.e., food banks, food distribution groups, local school), industry partners and other academics involved in the project. Both the combinations and labels used to describe the attributes were considered in detail and various changes made. Given the nature of the research project which has been described as a “collaborative social innovation case study” the set of attributes we selected captured key aspects of the fish finger and how it came into being and how it is to be produced. As such the final set of attributes we employed was considered at length. Finally, once we had agreement within the project regarding our attribute set and associated description, we piloted the survey instrument to assess respondent understanding and engagement. Our pilot study indicated that survey respondents engaged with the survey instrument as we anticipated. Given this we moved to full data collection.”

We initially generated a set attributes through a review of the relevant DCE literature followed by several rounds of consultation with project partners to ensure that the attributes captured the product's salient and implementable characteristics. As noted in the Introduction, we wanted to capture not only the local nature of the fish used in the fish finger but also the role that co-creation played in producing the final product.

The DCE was designed assuming a standard 300 gram pack of ten fish fingers with price levels reflecting the range encountered by shoppers. Thus, the fish finger we employed in the DCE can be viewed as being equivalent to those currently on the market. We did not

employ the actual form of PFF given its limited level of production and commercial availability. The final set of attributes employed in each of the three DCE (PFF, GFF and LFF) are shown in Table 1:

The attributes shown in Table 1 incorporate some that are closely associated with the PFF project (i.e., locally sourced, locally produced, co-created) and others that have been examined in the broader DCE literature, albeit less frequently than attributes such as eco-labels or price (i.e., under-utilised, sustainably caught). What is novel about our DCE is the combination of these attributes, which together capture the distinctive characteristics of a locally co-created product using under-utilised species.

3.1.2. Experimental design

We designed 36 choice cards each with two options and a no choice. We generated the choice cards using a conservative D-optimal design (Scarpa & Rose, 2008) assuming a multinomial logit (MNL) specification and uninformative priors, using Ngene 1.4.0. The 36 choice cards were then divided into three blocks of 12 choice tasks. While our experimental design will have lower efficiency than if we employed an optimised designs assuming random heterogeneity, like Hess et al. (2017) we had no strong priors, and preferred to take a more conservative approach to design.

The question that we employed to frame the DCE was as follows:

“We are asking you to imagine that you are shopping. You are considering buying a 300gram pack of 10 Plymouth Fish Fingers as part of your weekly shop. We want you to consider which if any of the 300gram packs you would buy. You have the choice not to buy if you prefer.”

An example choice card is shown in Fig. 1.

Finally, the DCE was included within a survey instrument composed of five sections. It started with a brief description of the research project. Section A included questions regarding respondents' current purchasing habits of fish. In Section B, we gave an overview of the DCE where we defined the attributes and levels as shown in Table 1. In Section C, we implemented the DCE, and this was followed by a series of debriefing questions in Section D and collection of socio-economic data in Section E.²

3.1.3. Data collection

We implemented three parallel DCEs, one for each of the location specific fish finger i.e., PFF, GFF and LFF. The experimental design, choice tasks, attributes, and levels was identical across locations; the only variation was the product label and how this was employed in the framing of the DCEs: “Plymouth Fish Finger,” “Grimsby Fish Finger,” or “Lowestoft Fish Finger”. The survey was distributed by Qualtrics, with respondents screened to be UK residents aged 18 or over who were at least partially responsible for household food shopping and who purchased fish. Within each location-specific version, quotas were applied to match the sample as closely as possible to the national distribution of age, gender, region, and household income.

We randomly assigned respondents to one of the three DCEs. After cleaning the data for missing values in the conditioning variables, the estimation samples comprised 625, 621, and 615 respondents for Plymouth, Grimsby, and Lowestoft, respectively. Summary distributions for income, age, education, and number of children are reported in Table 2. Given our sampling criteria it can be seen that sample compositions are broadly comparable across locations. Postcodes also were collected for all respondents. The distributions of straight-line distances from each area's centre are shown in Fig. A.1 (Appendix A). Participants in the Plymouth sample lived, on average, somewhat farther from the centre than those in Grimsby and Lowestoft which reflects the geography of the chosen locations. We collected this data to examine the extent to which proximity to a given, location might be correlated with WTP.

² An anonymised copy of the survey is provided as an attachment to the manuscript.

Table 1
DCE attributes.

Attribute	Description	Levels
Price (£)	Price for a single 300gram pack of 10 fish fingers	0.75, 1.25, 1.75, 2.50, 3.75 & 5.00
Locally Source	The fish finger is produced using fish caught by the Plymouth fishing fleet using fishing vessels less than 10 m long. If NOT locally sourced, then the fish has been caught by another fishing fleet.	Yes or No
Locally Produced	The fish finger is produced on the Plymouth fish quay by local fishing industry partners. If NOT locally produced then the fish finger is produced at a location other than Plymouth.	Yes or No
Co-created	The fish finger has been jointly created and taste tested by the local community and fishing industry working together. If NOT co-created, then the fish finger has been created by a food manufacturer.	Yes or No
Under-utilised	The fish finger is produced using under-utilised fish species caught by the Plymouth fishing fleet. These are fish species that are typically discarded and not normally used to make fish fingers. If NOT using under-utilised fish species, then the fish finger is made from commonly used species.	Yes or No
Sustainably caught	The fish have been caught following industry sustainability guidelines or the fish have NOT been caught following any sustainability guidelines.	Yes or No

Choice Task 2 of 12

Please select the option that you prefer

Attributes	Fish Finger 1	Fish Finger 2
Price	£1.75	£2.50
Locally Sourced	No	Yes
Locally Produced	Yes	No
Co-Created	No	Yes
Under-Utilised	No	No
Sustainably Caught	Yes	No

If you want to see the attribute definitions click on this [link](#). Please select the option you prefer

- ☐ Fish Finger 1
☐ Fish Finger 2
☐ No choice

Fig. 1. Example choice task.

4. Econometric specification and estimation

4.1. Hierarchical Bayesian estimation

A hierarchical Bayesian (HB) approach offers advantages in the estimation of DCEs, particularly regarding the treatment of respondent heterogeneity. As Ramsey et al. (2026) highlight, hierarchical models utilise a process of “shrinkage”, where individual parameter estimates are pulled towards the population-level group mean. This mechanism is especially valuable in DCE where the number of observations per

person is often low, as it avoids the overfitting of individual estimates that sometimes occurs in classical models (Ramsey et al., 2026). The HB approach is essentially the same structure as the “mixed logit”. However, the Bayesian paradigm provides exact results in finite samples, without relying on the large-sample asymptotic arguments required by frequentist methods. The full posterior for the latent variables (e.g., the individual level estimates) can be modelled within the Bayesian approach, whereas both the estimation and inference for these components can be difficult and/or problematic in high dimensional random effects models.

Table 2
Descriptive statistics.

Variables	Plymouth	Grimsby	Lowestoft
Income Level			
< £5000	21	13	22
£5001-£10000	18	21	12
£10001-£20000	68	76	69
£20001-£30000	103	100	99
£30001-£40000	121	96	116
£40001-£50000	72	78	78
£50001-£65000	57	65	60
£65001-£80000	49	47	58
> £80000	104	98	88
Prefer NTS	12	27	13
Age (Years)			
18–25	94	93	90
26–35	128	128	124
36–45	133	133	130
46–55	128	128	128
56–65	85	81	84
Over 66	50	54	50
Prefer NTS	5	3	7
Number of Children			
0	270	270	277
1	137	150	124
2	182	154	160
3	27	36	36
4+	6	7	11
Prefer NTS	3	4	7

Note: Prefer NTS - Prefer Not To Say.

Additionally, the Bayesian framework provides a platform for the integration of non-sample information that mirrors the information that is used in experimental designs, such as a feasible price range. These priors can be weak in the sense of being largely dominated by the data yet induce curvature in the posterior in regions that are problematic in the sense of having a relatively flat likelihood. Priors can also be used to impose theoretical constraints — such as ensuring a negative price coefficient — which can be more straightforward to implement than the constrained maximum likelihood approaches used in frequentist analysis.

4.2. Model specification

Each respondent is denoted as $j \in \{j\}$ and they face a set of tasks $t \in \{t\}_j$. Each task is composed of two options $i \in (1, 2)$ along with a no-choice $i = 3$. The choices for the i th option made in the t th trial by the j th person are denoted as $y_{ijt} = 1$ if that option is chosen and $y_{ijt} = 0$ otherwise. The WTP for the k th attribute by the j th person is denoted as WTP_{kj} .

We adopt a WTP model parameterisation (Balcombe et al., 2010) whereby the systematic utility of the j th person for the i th option in the t th trial. This means have estimated the model in WTP space. The attraction of employing a WTP space model specification is that the marginal rate of substitution (i.e., the WTP estimates) are recovered directly and these estimates have been found to be more stable than preference-space model estimates (Balcombe et al., 2009; Scarpa & Rose, 2008). Our model is defined as³:

³ Note we also estimate the same model treating the opt-out options as non-informative rather than specifying the SQ. We present these in an appendix

$$V_{ijt} \propto \begin{pmatrix} -Price_{ijt} \\ +WTP_{1j} \times Locally_Sourced_{ijt} \\ +WTP_{2j} \times Co_Created_{ijt} \\ +WTP_{3j} \times Under_Utilised_{ijt} \\ +WTP_{4j} \times Sustainably_Caught_{ijt} \\ +WTP_{5j} \times Under_Utilised_{ijt} \\ +WTP_{6j} \times Option_1_{ijt} \\ +WTP_{7j} \times Optout_{ijt} \end{pmatrix} \quad (1)$$

where the $Price_{ijt}$ is treated as a continuous variable with six values between £0.75 and £5.00 and all other variables are dummies which take the value one if the option has the attribute in question and zero otherwise (e.g., $Locally_Sourced_{ijt} \in (0, 1)$).

The random utility of each option presented to individuals (U_{ijt}) is therefore defined as:

$$U_{ijt} = e^{\varphi_j} V_{ijt} + e_{ijt} \quad (2)$$

where e_{ijt} is an independent Gumbel distribution. Conditional on a choice being made, it follows that the probability of the first option being chosen in the t th task by the j th person is:

$$p_{it} = \frac{\exp(e^{\varphi_j} V_{ijt})}{\sum_{i=1}^3 \exp(e^{\varphi_j} V_{ijt})} \quad (3)$$

The likelihood of all the observed choices Y given the parameters that define all choices (Λ) is defined as:

$$L(Y|\Lambda) = \prod_{j \in \{j\}} \prod_{t \in \{t\}_j} \prod_{i=1,2,3} p_{ijt}^{y_{ijt}} \quad (4)$$

The scale parameter $\exp \varphi_j$ is defined by the distribution:

$$\varphi_j = \varphi_0 + u_{0j} \quad (5)$$

where $u_{0j} \sim N(0, \sigma_0^2)$.

Using $f(x) = \ln(\frac{x}{\bar{x}})$, and $g(x) = x - \bar{x}$, the WTP for the k th attribute is then conditioned on the following individual respondent data: *Income*, *Child* (Yes or No), *Distance* from the *Location* (i.e., Plymouth, Lowestoft and Grimsby) and *Location* dummies. This yields the following specification:

$$WTP_{kj} = \lambda_{k0} \quad (6)$$

$$+ \lambda_{k1j} f(Income_j) + \lambda_{k2j} g\left(\underbrace{Child_j}_{yes=1, no=0}\right) + \lambda_{k3j} f(Distance_j) \\ + \lambda_{k4j} g\left(\underbrace{Grimsby_j}_{yes=1, no=0}\right) + \lambda_{k5j} g\left(\underbrace{Lowestoft_j}_{yes=1, no=0}\right) + u_{kj}$$

where $u_{kj} \sim N(0, \sigma_k^2)$ for all k .

With this model specification and normalisations it follows that λ_{k0} is the WTP at the mean of the conditioning variables. Our estimation approach is Bayesian and therefore the posterior distribution for all parameters Λ given all choices Y is:

$$f(\Lambda|Y) \propto L(Y|\Lambda) f(\Lambda) \quad (7)$$

where $f(\Lambda)$ is the prior distribution for these parameters.

The posterior is mapped using Hamiltonian Monte Carlo Markov Chains (HMC). MCMC algorithms simulate the posterior by starting from an arbitrary set of values then after a given number of iterations (called a burn-in) will visit a high-density region within the posterior. The “tuning values” for the algorithm are also set during this phase. Further iterations are then performed with values being sampled from this posterior. After a sufficient number of values are sampled (e.g., 10,000) these values then serve as the basis for giving point estimates (which are taken as the mean of the posterior) and standard deviations (which are analogous to standard errors) for the parameter estimates. Throughout we also give the 5% and 95% percentiles of

these distributions. These are termed “(90%) credible intervals” in Bayesian terminology but are analogous to 90% confidence intervals in frequentist/classical analysis. It is conventional to run multiple chains to give independent posteriors that should not be identifiably different from each other (where by, if the posteriors from different chains are essentially the same this is termed “convergence”). Here we used 10, and chains were monitored for convergence (using plots and the R-Hat criteria) and these results indicated that convergence was achieved for all models estimated.⁴

5. Results

5.1. Attribute importance and non-attendance

We first examine the perceived importance of the attributes by all respondents. In the survey, respondents ranked the attributes in terms of importance and, after completing the choice tasks, they stated whether they ignored any attribute (attribute non-attendance (ANA)). The results are reported in [Appendix A](#) (see [Tables A.1](#) and [A.2](#) and [Fig. A.2](#)). Price is ranked first in all locations, followed by Locally Sourced, Sustainably Caught, and Locally Produced. These rankings are partly inconsistent with the stated ANA of Price, and the rankings for other attributes do not clearly align with the reported ANA. Across respondent groups, both the rankings and ANA data suggest that Under-Utilisation and Co-Creation were viewed as less important and were more likely to be ignored.

The relationship between importance rankings and stated attention is complex because respondents do not always interpret questions as intended. Eye tracking evidence shows that people who visually attend to attributes may still report ignoring them. Similarly, although rankings/attendance and utility inferred from choice are related (see [Balcombe et al., 2015](#); [Fraser et al., 2021](#)), that relationship is weak.

Broadly, one might expect higher stated non attendance (ANA) to correspond with lower attribute rankings. It is logically consistent for respondents to report attending to an attribute yet rank it as unimportant; by contrast, reporting non attendance but ranking an attribute highly is harder to reconcile. Viewed this way, our data are not entirely consistent with expectations. Under Utilisation and Co Creation were both ranked lower and more likely to be reported as ignored, but for other attributes rankings and reported ANA do not align clearly.

The relationship between importance rankings and stated non attendance warrants further investigation. We speculate respondents may distinguish between how they consider an attribute in the experimental context and how they view it in general. For example, price may be perceived as an important factor in purchasing fish fingers overall, yet not pivotal within the experiment, leading respondents to report not attending to it. Targeted qualitative work to probe these distinctions would be valuable.

5.2. WTP estimates

Next we consider the model estimates with the results presented in [Table 3](#). The second column (Estimate) is the mean estimate of the posterior distribution. These are WTP estimates for the attributes along with an estimate of the predisposition of people to choose the first option (i.e., Option 1, to assess if there is a bias to always choose that option) and the estimate of the distribution for the scale parameter (e^{ϕ_0} as in [\[\(2\)\]](#)).

[Fig. 2](#) gives the same information as in [Table 3](#), that is the WTP parameters for the five attributes. As can be seen from [Table 3](#) and [Fig. 2](#), all WTPs are positive and range from £0.96 for Co-Creation to £1.87 for being Sustainably Caught. Given the confidence intervals, we are quite confident that being Sustainably Caught is the most important attribute in terms of WTP with the next being Locally Sourced with a WTP of £1.47.

⁴ All priors employed in estimation are described in full in [Appendix B](#). All model diagnostics are reported in [Appendix C](#).

Table 3

Mean Estimates (WTP plus Other parameters).

Attributes	Estimate	Std*	5%**	95%**
Scale	1.286	0.027	1.243	1.331
Locally Sourced	1.544	0.028	1.499	1.590
Locally Produced	1.190	0.026	1.146	1.231
Co-Created	1.178	0.040	1.112	1.245
Under-Utilised	1.329	0.039	1.264	1.393
Sustainably Caught	1.816	0.031	1.765	1.866
Option A	0.078	0.030	0.028	0.127
Opt Out	-1.307	0.057	-1.402	-1.212

Note: Std - standard deviation for posterior mean.

* The std is (analogous to standard error in frequentist estimation).

** 5% and 95% percentiles for the mean (analogous to 90% confidence interval).

Table 4

Location effects.

Attribute	Location	Mean	Std*	5%**	95%**
Locally Sourced:	Grimsby	0.094	0.069	-0.020	0.205
	Lowestoft	-0.073	0.072	-0.191	0.045
Locally Produced	Grimsby	-0.102	0.064	-0.205	0.003
	Lowestoft	-0.106	0.066	-0.214	0.001
Co Created	Grimsby	0.052	0.099	-0.110	0.215
	Lowestoft	0.160	0.104	-0.009	0.332
Under Utilised	Grimsby	0.129	0.095	-0.029	0.285
	Lowestoft	-0.086	0.098	-0.244	0.075
Sustainably Caught	Grimsby	-0.025	0.075	-0.147	0.099
	Lowestoft	-0.106	0.078	-0.234	0.021

Note: Std - standard deviation for posterior mean.

* The std is (analogous to standard error in frequentist estimation).

** 5% and 95% percentiles for the mean (analogous to 90% confidence interval).

5.2.1. WTP and individual characteristics

Next, we examine if the individual respondent characteristics influence their WTPs. First, we consider the locations in terms of whether they differed from Plymouth. These results are presented in [Table 4](#) and [Fig. 3](#). These numbers presented indicate the difference in the WTP for each attribute in terms of Location relative to Plymouth.

As can be seen from [Table 4](#) and [Fig. 3](#) the confidence intervals mostly contain zero, with a couple of exceptions, most notably that Grimsby has a larger WTP for Under-Utilised and Locally Sourced than for Plymouth. Lowestoft does not contain any significant differences compared to Plymouth with regard to any of the attributes.

Next, the impact of Income, Distance and Child effects are presented in [Table 5](#) and [Fig. 4](#). As outlined in [\[\(6\)\]](#) Income and Distance are in logged form, whereas Child is whether or not the respondent had a child in their household.

In [Table 5](#), if we consider Sustainably Caught the numbers can be interpreted as, every doubling/halving of income lead to a £0.247 increase/decrease in the WTP if the fish used to produce the fish finger was Sustainably Caught. In comparison a doubling/halving of the distance from the Location origin lead to a decrease of £0.004 and having a child decreased WTP by £0.073. These results are illustrated in [Fig. 4](#).

Overall what we can see is that Income generally had a positive impact on the WTPs across all of the attributes. However, whereas we hypothesised an increase in distance would cause a reduction in the WTP for the attributes it did not have a significant effect. By contrast, we see that for most of the attributes with the exception of being Sustainably Caught, having a child generally signalled a greater WTP for each of the attributes. It is therefore notable that while being Sustainably Caught had the largest WTP, neither distance nor having children impacted this WTP.

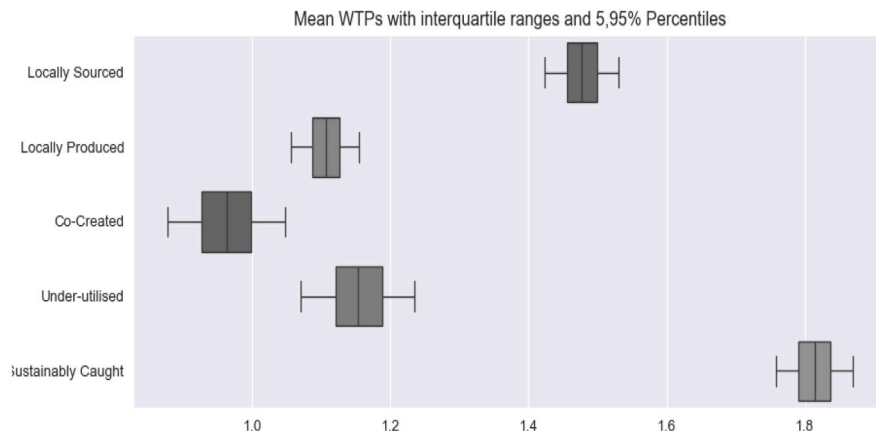


Fig. 2. Mean WTP estimates and confidence intervals.

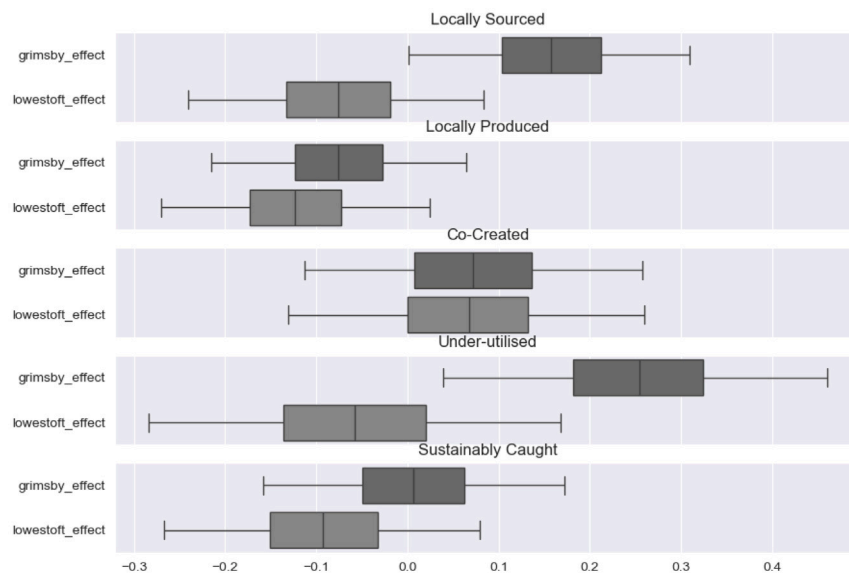


Fig. 3. Location effects.

Table 5
Income, Distance and Child Effects.

Attribute	Variable	Mean	Std*	5%**	95%**
Locally Sourced:	Income	0.090	0.036	0.030	0.149
	Child	0.161	0.057	0.067	0.255
	Distance	-0.014	0.053	-0.102	0.073
Locally Produced	Income	0.145	0.033	0.089	0.200
	Child	0.310	0.054	0.222	0.400
	Distance	-0.050	0.049	-0.132	0.030
Co Created	Income	0.087	0.052	0.003	0.173
	Child	0.371	0.083	0.232	0.510
	Distance	0.086	0.076	-0.039	0.211
Under Utilised	Income	0.148	0.050	0.066	0.230
	Child	0.147	0.080	0.015	0.276
	Distance	0.033	0.072	-0.086	0.153
Sustainably Caught	Income	0.217	0.040	0.153	0.282
	Child	-0.036	0.064	-0.140	0.067
	Distance	-0.029	0.058	-0.123	0.064

Note: Std - standard deviation for posterior mean.

* The std is (analogous to standard error in frequentist estimation).

** 5% and 95% percentiles for the mean (analogous to 90% confidence interval).

5.3. Decomposition of WTP by income group

Since Income was found to be such an important attribute, we decomposed WTP by income group to draw out the mean WTPs for individuals between different income bands. We wanted to examine if it was possible that while the mean WTP was positive it was not so for lower income groups. These results are reported in Table 6 along with the percentages of people having a positive WTP (if less than 100%).

As can be observed from Table 6, the lowest income group is estimated to have a WTP over 80p for Co-Created fish finger and as much as £1.50 for fish that is Sustainably Caught. Moreover, the percentages given in Table 6 show that at least 90% of people were prepared to pay a positive amount for each attribute regardless of income level.

6. Discussion

6.1. Consumer choice and product attributes

Our results reveal important insights into the potential consumer response to food products that are co-created and locally produced.

First, the Sustainably Caught attribute generated the largest WTP, which is consistent with many prior studies showing that, when consumers are given information about environmental practices, environmental attributes are among the strongest drivers of choice (Paci et al.,

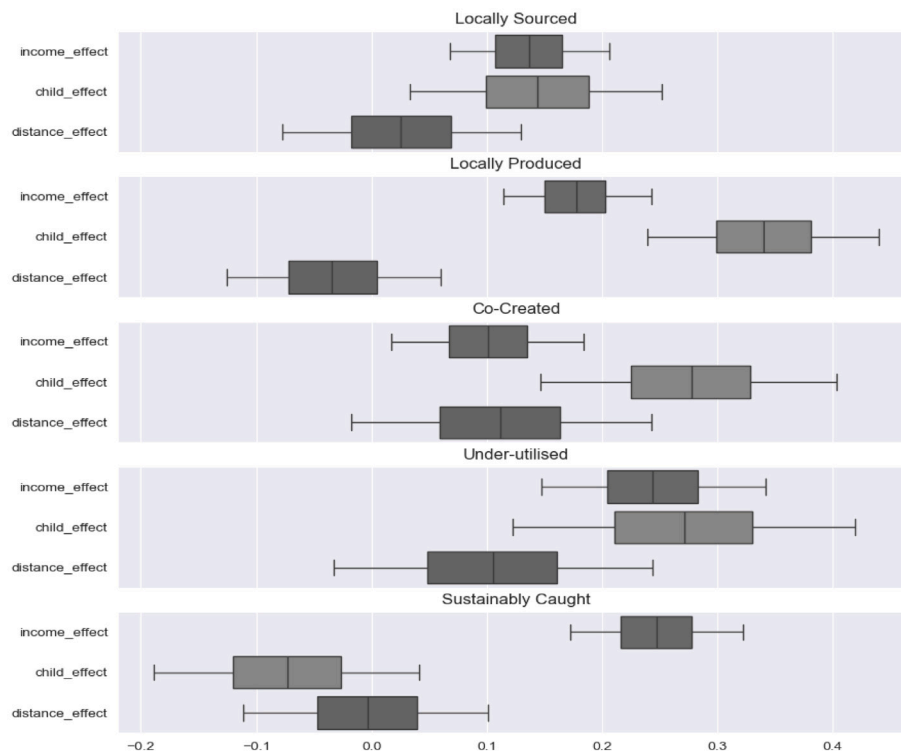


Fig. 4. Income, Distance and Child effects.

Table 6
Mean WTPs by income group.

Attributes	<£20k	£20k-£40k	£40k-£60k	£60k-£80k	>£80k
Locally Sourced	1.42 (99%)	1.51 (99%)	1.56	1.66	1.71
Locally Produced	0.95 (99%)	1.14 (99%)	1.18	1.31 (99%)	1.53
Co-Created	1.02	1.12	1.16	1.34	1.45
Under-utilised	1.16 (96%)	1.22 (98%)	1.34 (99%)	1.50 (99%)	1.66 (99%)
Sustainably Caught	1.55 (99%)	1.79	1.82 (99%)	2.00	2.05

Note: Percentages is proportion of that group prepared to pay a positive amount if less than 100%.

2018; Xhakollari et al., 2025). We did not test a specific sustainability label, unlike much of the literature that focuses on the Marine Sustainability Certificate (MSC) label. Nevertheless, the information provided to survey respondents produced a substantial price premium. This invites the question of whether the observed value derives from the label itself or from credible sustainability information without branding.

Second, the next most valued attribute was Locally Sourced fish. However, the remaining attributes i.e., Co-created, Under-Utilised and Locally Produced, although positively valued generated much lower WTP estimates. We also tested whether proximity (i.e., distance) to the focal localities (e.g., Plymouth, Grimsby and Lowestoft) effected WTP for the locality attributes. In general, we found little evidence that it did. We interpret this result as indicating that respondents valued information about sourcing and place of production, but geographic proximity to those places did not materially affect WTP. Thus, we find no distance gradient; claims that visible fishing activity strengthens local preferences are not supported here, suggesting another line for future investigation (Martino et al., 2023).

Third, what we might refer to as our social sustainability attributes are the least valued by consumers (Schrobbach et al., 2025). In this case, it might be argued that policy makers act on two fronts: (i) sustained public communication to raise salience; and (ii) binding minimum standards for the fishing industry that guarantee social outcomes

regardless of WTP. Because label effects are species-dependent (Asche & Bronnmann, 2017), the valuation of other attributes is also likely to vary by species and product form as well. Communication about non-discarded fish should therefore be tailored and, potentially supported by regulation. We also note, that survey respondents may not appreciate that why consuming non-discarded fish is potentially desirable. To address this possibility, we estimated an additional model including an interaction between the under-utilised and co-created attributes that can be interpreted as a proxy for trust or quality signal mitigating potential negative perceptions. The results, shown in Table A.3 in the Appendix yield and insignificant estimate. However, this issue warrants more attention in future research.

Fourth, another aspect of the results presented is that our respondents do not appear to value differently a product that is produced at a working fish port compared to one which is no longer operating. Plymouth is sometimes referred to as “Britain’s Ocean City” and has annual seafood landing such that it is the third largest in the south-west and seventh in UK. In contrast Lowestoft only has an historical attachment to the fishing industry. This would suggest that reliance on a name alone, without additional contextual information will not result in any additional value being created for a product such as the fish finger considered in this study.

More generally, what these results indicate is that a bespoke product in terms of origin as well as design and production did not generate

large additional economic value. However, the value estimates generated reveal support for the case made by Boncinelli et al. (2025) that in order to reduce the negative externalities associated with discards and bycatch the fishing industry should attempt to induce greater demand for low value fish species. This in part will require a diversification of current species purchase and consumption patterns. Currently, in the UK, consumer demand for fish is highly concentrated on five species (i.e., cod, haddock, salmon, tuna and prawns) representing 80% of seafood consumption (Ferrini et al., 2025; Garibay-Yayen & Willer, 2025; Marine Stewardship Council, 2025). This pattern of demand has been observed in the UK since the 1970's (Thurstan, 2025).

6.2. New product creation

The PFF yields several potential benefits for both consumers and fishers. First, the fish finger would result in the use of more domestically caught fish from a larger set of species to meet consumer demand and this might in part help to address some of the issue identified by Löfstedt et al. (2025). In particular, they note that UK fish consumption and associated dietary recommendations are not satisfied by domestic production. Also, Garibay-Yayen and Willer (2025) note that diversification of seafood would have positive health impacts. The Plymouth fish finger or similar such products could start to address this issue.

Second, a targeted consumer awareness campaign (e.g., Tanner et al., 2021) that increases awareness of the new product could help with establishing its position in the market. A benefit of a fish finger is that being a processed product it reduces cooking and preparation uncertainty can mitigate confusion around the cooking of fish (Boncinelli et al., 2025).

Third, by making greater use of fish that are either discarded or have low economic value then PFF is generating value from what has traditionally been a source of waste. As such the new product could enhance sustainability by essentially generating value. The potential for converting what has traditionally been regarded as waste in fishing has been discussed at length by Cooney et al. (2023). As they explain large amounts of valuable biomass have simply been lost as a result of bycatch and discarding.

6.3. Scaling up production

Although the PFF and related products offer significant benefits there is the obvious challenge associated with scaling up production. If, we take the PFF as an example, the challenges are not simply related to manufacturing of the product but also the supply of fish that go into the final product. As currently prepared, the PFF is produced using three species: Dog Fish, Pouting and Whiting (Hunt et al., 2026). Pouting is typically regarded as a nuisance fish and as such is either discarded or used as a baiting fish. In contrast, both Dog Fish and Whiting are commercially landed although the prices paid are relatively low. For example, as of November 2025 the prices paid for Dog Fish is £ 384 per tonne and for Whiting £ 1320 per tonne. These are very low when compared to other fish species such Cod (£4510) and Sole (£17,010) (Marine Management Organisation (MMO), 2025). The relatively low prices for these species in part explains why they are frequently discarded or landed when other higher value species have not been caught.

In terms of stock assessment for the three species there is data provided by Marine Conservation Society. For Pouting although there is no formal monitoring of the stock it is suggested that the population is declining. For Dog Fish there is little active management and not much is known about population levels. For Whiting there is fishing quota⁵ in place and it is reported that catches are in decline which

has in turn resulted in stock levels being “below” safe biological levels (Marine Conservation Society (MCS), 2025).

What we learn from this data is that scaling up production if the focus is to be on these three species is that greater attention will need to be paid to stock levels. Although efforts to ensure that discards are reduced and that resulting use of fish biomass is beneficial to both fishers and consumers there needs to be sufficient attention given to stock management to avoid unintended consequences from over fishing. This is especially case with Whiting that is already considered to be at stock levels below that required to maintain sustainability and also the importance attached by consumers to fish that are sustainably caught.

6.4. Limitations

This study as with many stated preference studies is potentially subject to several limitations.

One concerns the risk of upward bias in WTP estimates for sustainability attributes, arising from social desirability, as respondents may overstate their preferences to conform to perceived social norms (e.g., Chung & Monroe, 2003; Entem et al., 2022). Given the hypothetical nature of the DCE, the observed premium for sustainably caught fish should therefore be interpreted with this caveat in mind.

A further limitation commonly raised against DCE research is hypothetical bias (HB), where respondents' stated preferences diverge from their real purchasing behaviour (Penn & Hu, 2021), a risk that increases when studies do not implement incentive-compatible procedures (Zawojnska & Czajkowski, 2017). Two features of our design limit this concern. First, DCEs generally perform well on internal validity, since researchers can control both the design (content validity) and data collection (construct and theoretical validity) (Haghani et al., 2021). The attention paid to the design and implementation of this study addresses this directly. Second, because we examine fish fingers, which are a well-known product type, respondents have a good sense of a reference price, which reduces the scope for HB even though construct validity itself is difficult to verify empirically.

Another potential limitation of any survey concerns sample composition. As explained in Section 3.1.3, we addressed this through a structured approach to data collection designed to ensure a nationally representative sample.

Finally, ANA presents a limitation of its own. We report stated ANA data alongside attribute ranks, and the correlation between the two is consistent with prior literature. However, eye-tracking evidence (e.g., Balcombe et al., 2015) shows that stated ANA can diverge significantly from actual visual attendance to DCE attributes, tends to be lower in practice than stated, and shows no clear correspondence with the values respondents attach to those attributes.

7. Conclusions

This study examined consumers' WTP for attributes of a fish finger product, focusing on three localities with historical and ongoing ties to the fishing industry. We assessed five attributes: three locality-related (locally sourced, locally produced, and co-produced with members of the local community), as well as being caught sustainably and using under-utilised species, mostly called “by catch” and “discarded fish” in the literature.

Our results indicate that respondents highly value fish that are caught sustainably regardless of product location. In contrast, even though co-creation is positively valued it is the lowest attribute for all fish fingers. We also find little variation in our WTP estimates by product location. We discuss the significance of our findings in terms of future product development and marketing implications.

This study provides evidence on UK consumer responses to sustainability attributes for a familiar processed food (fish fingers) using a DCE. Future work might compare multiple processed product forms

⁵ See DEFRA and MMO (2024) for details.

that use non-discarded fish and assess their performance across different UK retailers. There is also the need for more transdisciplinary research on how a local product can develop a brand identity that will attract a price premium that results in benefits for the local communities involved in production. It remains to be seen if co-creation can be sufficiently leveraged to this effect and if it can also contribute to ethical consumption through procedural value.

CRedit authorship contribution statement

Jessica Bosseaux: Writing – review & editing. **Kelvin Balcombe:** Software, Resources, Methodology, Data curation, Conceptualization. **Iain Fraser:** Writing – original draft, Visualization, Investigation.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Kelvin Balcombe reports financial support was provided by Biotechnology and Biological Sciences Research Council. If there are other authors, they 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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Appendix A. Attribute engagement

See Tables A.1–A.3.

See Figs. A.1 and A.2.

Table A.1
Numbers stating ANA.

Attribute	Plymouth%	Grimsby%	Lowestoft%	Average%
Price	20.2	21.8	19.5	20.5
Locally Sourced	14.7	15.3	12.7	14.3
Co-created	21.7	19.5	22.6	21.2
Under Utilised	17.7	17.2	17.9	17.6
Sustainably Caught	13.2	12.8	13.5	13.2
Locally Produced	12.4	13.4	13.8	13.2

Table A.2
Average attribute rank (1 High, 6 Low).

Attribute	Plymouth	Grimsby	Lowestoft	Average
Price	2.35	2.26	2.26	2.29
Locally Sourced	2.59	2.65	2.59	2.61
Co-created	4.60	4.63	4.54	4.56
Under Utilised	4.53	4.50	4.69	4.56
Sustainably Caught	3.12	3.21	3.16	3.13
Locally Produced	3.80	3.82	3.78	3.80

Table A.3

Model including under-utilised and co-created interaction.

Attributes	Estimates	Std*	5%**	95%**
Scale	1.291	0.026	1.247	1.335
Locally Sourced	1.545	0.028	1.499	1.590
Locally Produced	1.193	0.026	1.150	1.236
Co-Created	1.238	0.040	1.172	1.302
Under-Utilised	1.265	0.041	1.198	1.331
Sustainably Caught	1.826	0.030	1.776	1.876
Co-Created x Under-Utilised	−0.102	0.079	−0.228	0.027
Option A	0.139	0.030	0.090	0.187
Opt Out	−1.233	0.059	−1.327	−1.135

Note: Std - standard deviation for posterior mean.

* The std is (analogous to standard error in frequentist estimation).

** 5% and 95% percentiles for the mean, analogous to 90% confidence interval.

Appendix B. Prior distributions

For succinctness, we use simpler notation than in the main text with the model being expressed as:

$$V_{ijt} \propto -\text{Price}_{ijt} + \sum_k \beta_{kj} x_{ijt,k} \quad (8)$$

thus β_{kj} is the WTP for the k th attribute by the j th person and $x_{ijt,k}$ are the attribute vectors that do not include the Price attribute. As in the main text, we define:

$$U_{ijt} = e^{\varphi_j} V_{ijt} + e_{ijt} \quad (9)$$

where e_{ijt} are independent Gumbel terms. The distributions of all the parameters have a Heirachical Bayesian structure such that

$$\varphi_j \sim N(\bar{\varphi}, \bar{\sigma}_{\varphi}^2) \quad (10)$$

and

$$\beta_{kj} \sim N(\bar{\beta}_k, \bar{\sigma}_k^2) \text{ for all } k \quad (11)$$

where

$$\bar{\varphi} \sim N(\mu_{\varphi}, \sigma_{\varphi}^2) \text{ and } \bar{\alpha} \sim N(\mu_{\alpha}, \sigma_{\alpha}^2)$$

$$\bar{\beta}_k \sim N\left(\lambda_k + \sum_w \tau_{wk} z_{w,j}, \sigma_k^2\right) \text{ for all } k$$

where $z_{w,j}$ are the explanatory variables such as Income, Age, Child, Distance and Location dummies (logged and/or normalised). The prior distributions are set such that

$$\bar{\sigma}_k^{-2} \sim \text{Gamma}\left(1, \frac{1}{10}\right) \text{ for all } k$$

$$\mu_{\varphi}, \mu_{\alpha}, \lambda_k, \tau_{wk} \sim N(0, 1) \text{ for all } k \text{ and } w \quad (12)$$

along with a truncation on the size of the WTPs such that no one attribute could have a WTP larger than the range of the prices in the experiment at the individual level ($\alpha_j, |\beta_{kj}| < £4.25$). Having a WTP that exceeds the range prices used in the experiment is a minimal condition for a coherent set of estimates. WTPs outside of these ranges would be totally inconsistent with the values that we see on the market (i.e., one attribute having a WTP greater than £4.25 would mean that the value of this one attribute exceeds the value of most fish-fingers on the market). However, while these help convergence of the MCMC algorithm, the posterior distributions that we estimate have masses that are concentrated on the interior of the posterior (i.e., not at the edge). Thus, the data is consistent with these restrictions.

Appendix C. Mhcmc diagnostics

See Table C.1.

See Fig. C.1.

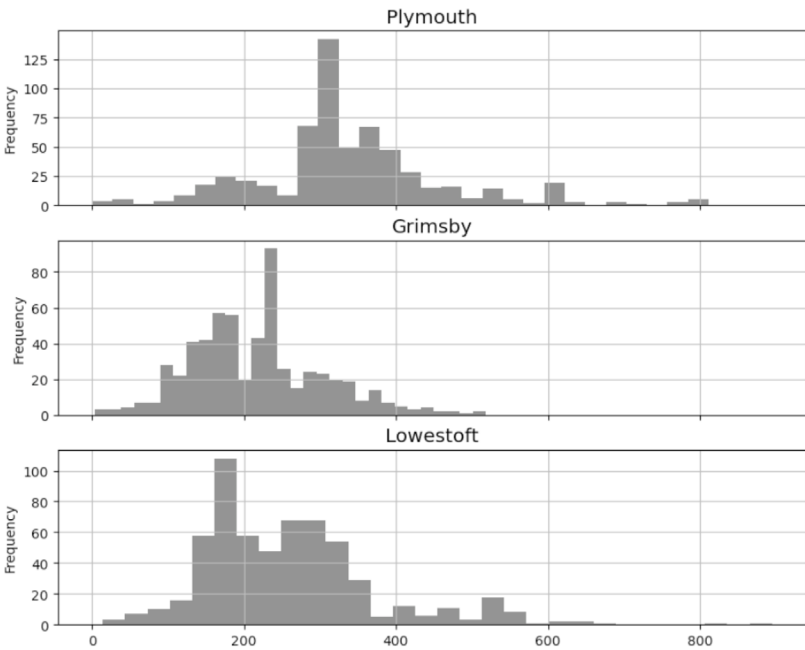


Fig. A.1. Distance from product home.

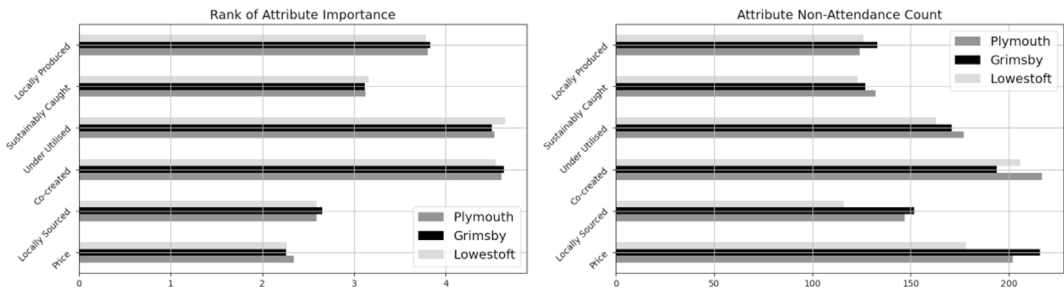


Fig. A.2. Rank and ANA non attendance.

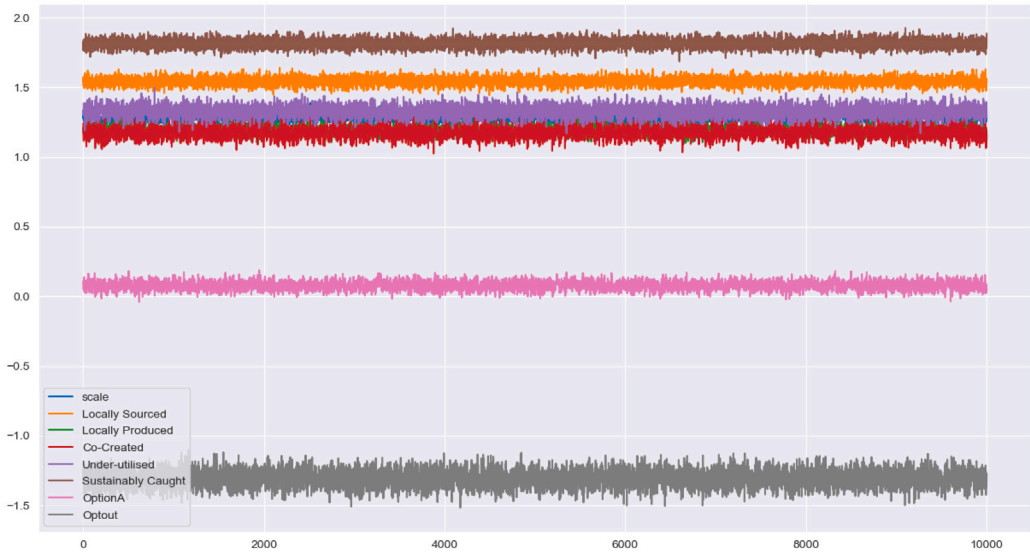


Fig. C.1. Trace convergence plots for attributes.

Table C.1
Rhat diagnostics for key WTP parameters.

Option 1	Scale	Locally sourced	Locally produced
1.002	1.0004	1.0003	1.002
Co-Created	Under Utilised	Sustainably Caught	Opt-out
1.001	1.001	1.0007	1.002

Note: A value < 1.05 is considered acceptable.

Appendix D. Supplementary data

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.foodqual.2026.106084>.

Data availability

Data will be made available on request.

References

Andreani, G., Tur-Cardona, J., Antoniolli, F., Barreiro-Hurle, J., Sogari, G., & Menozzi, D. (2026). To label or not to label? A meta-regression analysis of consumer willingness to pay for sustainability claims. *Trends in Food Science & Technology*, Article 105435.

Arman, S. M., & Mark-Herbert, C. (2024). Ethical consumption: a review and research agenda. *International Journal of Consumer Studies*, 48(5), Article e13079.

Armbrecht, J., Lundberg, E., & Skallerud, K. (2023). A segmentation of fish consumers based on quantity and type of fish: Insights from the Swedish market. *Food Quality and Preference*, 112, Article 105007.

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners*, 35(4), 216–224.

Asche, F., & Bronnmann, J. (2017). Price premiums for ecolabelled seafood: MSC certification in Germany. *Australian Journal of Agricultural and Resource Economics*, 61(4), 576–589.

Balcombe, K., Chalal, A., & Fraser, I. (2009). Model selection for the mixed logit with Bayesian estimation. *Journal of Environmental Economics and Management*, 57(2), 226–237.

Balcombe, K., Fraser, I., & Di Falco, S. (2010). Traffic lights and food choice: A choice experiment examining the relationship between nutritional food labels and price. *Food Policy*, 35(3), 211–220.

Balcombe, K., Fraser, I., & McSorley, E. (2015). Visual attention and attribute attendance in multi-attribute choice experiments. *Journal of Applied Econometrics*, 30(3), 447–467.

Beukhof, E. D., Uhlmann, S. S., van der Reijden, K. J., Anastasopoulou, A., Altuna-Exabe, M., Astarloa, A., ..., Brown, E. J. (2026). From bycatch to litter: a systematic map of the ecological impacts of fishing in European seas. *Reviews in Fish Biology and Fisheries*, 36(1), 9.

Boncinelli, F., Gelici, C., Secci, G., Casini, L., & Parisi, G. (2025). Sustainability and tradition as implicit cues for promoting low-market-value fish dishes in restaurants. *Agricultural and Food Economics*, 13(1), 72.

Boughanmi, H., Al-Musalami, J., Al-Oufi, H., & Zaibet, L. (2007). Estimating consumer preferences for value-added fish products in oman: A conjoint analysis. *Journal of Food Products Marketing*, 13(2), 47–68.

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.

Budhathoki, M., Xu, H., Ma, Z., Campbell, D., Zhang, W., Li, S., Newton, R., & Little, D. (2025). Consumers' preferences toward farmed salmon in China: Integrating sensory and choice experiments. *Food Frontiers*, 6(2), 1008–1026.

Cantillo, J., Martín, J. C., & Román, C. (2020). Discrete choice experiments in the analysis of consumers' preferences for finfish products: A systematic literature review. *Food Quality and Preference*, 84, Article 103952.

Caputo, V. (2025). From choice to context: Rethinking food environments, consumer agency and policy action. *European Review of Agricultural Economics*, 52(4), 685–724.

Chung, J., & Monroe, G. S. (2003). Exploring social desirability bias. *Journal of Business Ethics*, 44, 291–302.

Cooney, R., de Sousa, D. B., Fernández-Ríos, A., Mellett, S., Rowan, N., Morse, A. P., Hayes, M., Laso, J., Regueiro, L., Wan, A. H., & Clifford, E. (2023). A circular economy framework for seafood waste valorisation to meet challenges and opportunities for intensive production and sustainability. *Journal of Cleaner Production*, 392, Article 136283.

De Graaf, G., & Paanakker, H. (2015). Good governance: Performance values and procedural values in conflict. *The American Review of Public Administration*, 45(6), 635–652.

DEFRA and MMO (2024). *Quota management rules for england and the crown dependencies*. Issued by the Department for the Environment, Food and Rural Affairs and the Marine Management Organisation., https://assets.publishing.service.gov.uk/media/66e945d7e4b40ed591881bf9/English_Quota_Management_Rules.pdf.

Domingie, S., Saint-Eve, A., Espinosa-Briset, L., Giboreau, A., & Cosson, A. (2025). Multi-actor co-creation of innovative protein-rich appetisers forolder adults: From the kitchen to real-life consumer tasting. *Food Quality and Preference*, Article 105660.

Durán, R., Farizo, B. A., & Vázquez, M. X. (2015). Conservation of maritime cultural heritage: A discrete choice experiment in a European atlantic region. *Marine Policy*, 51, 356–365.

Durco, B. B., Farias, C. O., Pimentel, T. C., Tavares Filho, E. R., Gambaro, A., Cruz, A. G., ..., Esmerino, E. A. (2025). Redefining innovation: the role of co-creation in collaborative new food product strategies. *Current Opinion in Food Science*, 63, Article 101298.

Entem, A., Lloyd-Smith, P., Adamowicz, W. V. L., & Boxall, P. C. (2022). Using inferred valuation to quantify survey and social desirability bias in stated preference research. *American Journal of Agricultural Economics*, 104(4), 1224–1242.

Ferrini, S., Bailey, L., Bark, R., Grilli, G., McHarg, E., & Pitchford, J. (2025). Socio-economic evidence for sustainable fisheries. <http://dx.doi.org/10.6084/m9.figshare.30741821.v1>.

Fraser, I., Balcombe, K., Williams, L., & McSorley, E. (2021). Preference stability in discrete choice experiments. Some evidence using eye-tracking. *Journal of Behavioral and Experimental Economics*, 94, Article 101753.

Garibay-Yayen, J. B. B., & Willer, D. F. (2025). Patterns, barriers, and drivers to the consumption of under-loved seafood species and parts in the United Kingdom. *Appetite*, Article 108196.

Giampietri, E., Verneau, F., Giudice, T. Del., Carfora, V., & Finco, A. (2018). A theory of planned behaviour perspective for investigating the role of trust in consumer purchasing decision related to short food supply chains. *Food Quality and Preference*, 64, 160–166.

Gilman, E., Roda, A. Perez., Huntington, T., Kennelly, S. J., Suuronen, P., Chaloupka, M., & Medley, P. a. H. (2020). Benchmarking global fisheries discards. *Scientific Reports*, 10(14017).

Govzman, S., Looby, S., Wang, X., Butler, F., Gibney, E. R., & Timon, C. M. (2021). A systematic review of the determinants of seafood consumption. *British Journal of Nutrition*, 126(1), 66–80.

Haghani, M., Bliemer, M. C., Rose, J. M., Oppewal, H., & Lancsar, E. (2021). Hypothetical bias in stated choice experiments: Part II. Conceptualisation of external validity, sources and explanations of bias and effectiveness of mitigation methods. *Journal of Choice Modelling*, 41, Article 100322.

Hammarlund, C., Svensson, K., Asche, F., Bronnmann, J., Osmundsen, T., & Nielsen, R. (2025). Eco-certification in aquaculture–economic incentives and effects. *Reviews in Fisheries Science & Aquaculture*, 33(3), 402–415.

Hess, S., Daly, A., Dekker, T., Cabral, M. O., & Batley, R. (2017). A framework for capturing heterogeneity, heteroskedasticity, non-linearity, reference dependence and design artefacts in value of time research. *Transportation Research Part B: Methodological*, 96, 126–149.

Hunt, L., Pettinger, C., Tsikritzi, R., & Wagstaff, C. (2026). Collaborative co-design for local blue food system transformation: the practicalities and challenges of the uk's (foodsequal) 'plymouth fish finger' pilot study. *Environmental Research: Food Systems*, 3(1), 015002.

Huttunen, S., Ojanen, M., Ott, A., & Saarikoski, H. (2022). What about citizens? A literature review of citizen engagement in sustainability transitions research. *Energy Research & Social Science*, 91, Article 102714.

Huttunen, S., Turunen, A., & Kaljonen, M. (2022). Participation for just governance of food-system transition. *Sustainability: Science, Practice and Policy*, 18(1), 500–514.

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, 215–228.

Kamiyama, R., Wakamatsu, H., Seko, T., & Ishihara, K. (2024). Consumer preference for label presentations of freshness, taste, and serving suggestion on fresh fish packages of Japanese flounder *paralichthys olivaceus*. *Fisheries Science*, 90(3), 529–544.

Löfstedt, A., Scheliga, B., Aceves-Martins, M., & de Roos, B. (2025). Seafood supply mapping reveals production and consumption mismatches and large dietary nutrient losses through exports in the United Kingdom. *Nature Food*, 6(3), 244–252.

Lokugamage, I. P., De Silva, W. N., & Aanesen, M. (2024). Consumer willingness to pay for sustainable seafood: A meta-analysis. *Journal of Food and Agriculture*, 17(2), 79–103.

- Macready, A. L., Hieke, S., Klimczuk-Kochańska, M., Szumiał, S., Vranken, L., & Grunert, K. G. (2020). Consumer trust in the food value chain and its impact on consumer confidence: A model for assessing consumer trust and evidence from a 5-country study in Europe. *Food Policy*, 92, Article 101880.
- Marine Conservation Society (MCS) (2025). Good fish guide. <https://www.mcsuk.org/goodfishguide/>.
- Marine Management Organisation (MMO) (2025). Monthly provisional UK sea fisheries statistics 2025. <https://www.gov.uk/government/statistics/monthly-sea-fisheries-statistics-november-2025>.
- Marine Stewardship Council (2025). What sustainable seafood species can you eat in the UK? Meet the nation's fishy favourites. <https://www.msc.org/uk/what-you-can-do/sustainable-fish-to-eat-in-the-uk>.
- Martino, S., Azzopardi, E., Fox, C., Chiaroni, E., Payne, E., & Kenter, J. (2023). The importance of local fisheries as a cultural attribute: insight from a discrete choice experiment of seafood consumers. *Maritime Studies*, 22(2), 22.
- McCluskey, J. J., & Hyink, J. (2026). How changing food preferences and technology are transforming food markets. *Journal of Agricultural Economics*, 77(2), 819–831.
- Mozumder, M. M. H., & Schneider, P. (2026). Advancing sustainability through the circular economy in small-scale fisheries: A global review of practices, challenges, and policy innovations. *Marine Policy*, 185, Article 107001.
- Natali, F., Cacchiarelli, L., & Branca, G. (2022). There are plenty more (sustainable) fish in the sea: a discrete choice experiment on discarded species in Italy. *Ecological Economics*, 196, Article 107413.
- Nnadiogbulam, J. C., Harbourne, N., & Grasso, S. (2025). Co-creation in new food development: Current trends, challenges, and future directions. *Future Foods*, Article 100832.
- Paci, F., Danza, A., Del Nobile, M. A., & Conte, A. (2018). Consumer acceptance and willingness to pay for a fresh fish-burger: A choice experiment. *Journal of Cleaner Production*, 172, 3128–3137.
- Parzonko, H., Sonnino, R., & Timotijevic, L. (2025). Procedural justice in participatory food system governance: An integrated framework. *Environmental Science & Policy*, 174, Article 104269.
- Penn, J. M., & Hu, W. (2021). The extent of hypothetical bias in willingness to accept. *American Journal of Agricultural Economics*, 103(1), 126–141.
- Pettinger, C., Parsons, K., Chavez-Ugalde, I. Y., Hunt, L., & Wagstaff, C. (2026). Using expert elicitation and systems mapping to support social innovation in the (blue) food system: The case of the UK's plymouth fish finger. *Journal of Human Nutrition and Dietetics*, 39, Article e70234.
- Prellezo, R., & Villasante, S. (2023). Economic and social impacts of the landing obligation of the European common Fisheries policy: A review. *Marine Policy*, 148, Article 105437.
- Ramsey, A. F., Yu, J., & Moeltner, K. (2026). Bayesian econometrics in agricultural and resource economics. *European Review of Agricultural Economics*, 53(1), 127–168.
- Ribeiro, A. C. P., Esmerino, E. A., Tavares Filho, E. R., Cruz, A. G., & Pimentel, T. C. (2025). Unraveling the potential of co-creation on the new food product development: A comprehensive review on why and how listening to consumer voices. *Trends in Food Science & Technology*, Article 104978.
- Rockström, J., Thilsted, S. H., Willett, W. C., Gordon, L. J., Herrero, M., Hicks, C. C., Mason-D'Croz, D., Rao, N., Springmann, M., Wright, E. C., & Agustina, R. (2025). The EAT–lancet commission on healthy, sustainable, and just food systems. *The Lancet*, 406(10512), 1625–1700.
- Roda, P., Gilman, E., Huntington, T., Kennelly, S. J., Suuronen, P., Chaloupka, M., & Medley, P. (2019). A third assessment of global marine fisheries discards. In *FAO, Fisheries and aquaculture technical paper: Vol. 633*, Rome: FAO.
- Roheim, C. A., Asche, F., & Santos, J. I. (2011). The elusive price premium for eco-labelled products: Evidence from seafood in the UK market. *Journal of Agricultural Economics*, 62, 655–668.
- Saidi, A., Cavallo, C., Giudice, T. Del., Vecchio, R., & Cicia, G. (2023). Consumer preferences for finfish: A systematic literature review. *Food Quality and Preference*, 105, Article 104786.
- Scarpa, R., & Rose, J. M. (2008). Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why. *Australian Journal of Agricultural and Resource Economics*, 52(3), 253–282.
- Schrobback, P., Zhang, A., Maxwell, C., Tacconi, F., Ujiie, K., Yang, S. H., Kim, M. K., Ha, T. M., Wardyani, L., Feng, N., & Saunders, C. (2025). Consumer preferences for seafood sustainability attributes: A comparative study of 12 markets. *Food Quality and Preference*, 130, Article 105538.
- Shaw, N., Hardman, C. A., Boyle, N. B., Craven, J., Dooley, J., Mead, B. R., Morgans, L., Mumby, H., & Pettinger, C. (2024). What does 'co-production' look like for food system transformation? Mapping the evidence across transforming UK food systems (TUKFS) projects. *Nutrition Bulletin*, 49(3), 345–359.
- Sogn-Grundvåg, G., Bronnmann, J., Pettersen, I. K., Asche, F., & Johansen, O. (2025). Can eco-labels tune a supply chain? The case of MSC-certified haddock from Norway. *Ecological Economics*, 236(C).
- Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of Management Review*, 20(3), 571–610.
- Tanner, M. K., Olivares-Arenas, M., Puebla, L., & Marin Jarrin, J. R. (2021). Shifting demand to sustainable fishing practices in Darwin's archipelago: a discrete choice experiment application for galapagos'certified Yellow-fin tuna. *Marine Policy*, 132, Article 104665.
- Thurstan, R. H. (2025). Declines in the diversity of fish represented in a british domestic magazine over the past 100 years. <https://www.preprints.org/manuscript/202510.1388>.
- Velázquez, A. L., Galler, M., Vidal, L., Varela, P., & Ares, G. (2022). Co-creation of a healthy dairy product with and for children. *Food Quality and Preference*, 96, Article 104414.
- Khakollari, V., Kaliji, S. Ahmadi., Cerjak, M., Mulazzani, L., Rocculi, P., & Camanzi, L. (2025). Promoting sustainability in seafood products: Consumer eco-labeling and shelf-life innovation preferences in Croatia, Italy, and Spain. *Journal of Food Products Marketing*, 1–19.
- Xuan, B. B. (2021). Consumer preference for eco-labelled aquaculture products in Vietnam. *Aquaculture*, 532, Article 736111.
- Xuan, B. B., Sandorf, E. D., Ngoc, Q. T. K., & Phong, T. N. (2025). Consumer demand for sustainably produced shrimp. *Australian Journal of Agricultural and Resource Economics*, 69(3), 526–539.
- Zawojaska, E., & Czajkowski, M. (2017). Re-examining empirical evidence on stated preferences: importance of incentive compatibility. *Journal of Environmental Economics and Policy*, 6(4), 374–403.