# Transition alimentaire durable et labels : le cas du marché français des produits de la pêche et de l'aquaculture

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COLLEGE SCIENCES
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Par


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**Sustainable food transition and labelling: the case of the French Fishery and Aquaculture Products market**

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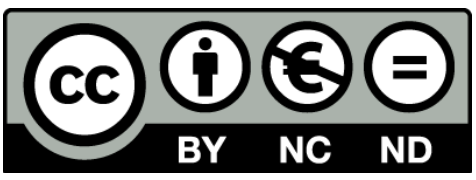
# PhD thesis

# Sustainable food transition and labelling: the case of the French Fishery and Aquaculture Products market



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Comment ne pas commencer par toi Vick, la seule personne qui, finalement, a eu (et fait) le choix de me supporter dans les personnes que je vais citer. Et quel choix as-tu fait… J'ai encore du mal à me l'expliquer, mais je te suis grandement et éternellement redevable de te l'être autorisé. S'il y a bien une personne à qui je dois énormément dans la réussite de ce projet, nul doute que tu dois être la première citée. Tu as toujours su me motiver et (surtout) me supporter au quotidien, malgré mon caractère quelquefois, disons, alambiqué! Du haut de ton jeune âge, tu es sans aucun doute la personne qui me pousse le plus à me questionner et à avancer, même si je doute un jour de pouvoir te rendre tout ce que tu m'as apporté ! Love love love.

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# Abstract

As food systems come under increasing scrutiny for their impact on the environment and human health, new ways of consuming are being promoted to achieve “sustainable and healthy” consumption patterns. In developed countries, the reduction of meat consumption is presented as an important lever. While vegetarian diets are on the rise, mixed diets can also offer an interesting alternative to the problems encountered. In this line, Fishery and Aquaculture products (FAPs) can be a viable alternative. Indeed; they are nutritious products (rich in OMEGA 3, mineral salts, etc.). More than that, FAP production is often described as more environmentally friendly than meat production. However, despite these interesting attributes, these products also have some limitations (overfishing, eutrophisation, health hazards, etc.) and their consumption needs to be managed in order to achieve the objective of sustainable and healthy food systems.

In this line, the general objective of this thesis is to better understand how we can guide consumers towards a more sustainable consumption of FAPs, with a particular focus on voluntary labelling. Here, we are interested in the concept of sustainability in a broad sense, not only in an environmental dimension. The French FAPs market is used as a reference market. Firstly, using three data sources, this work shows that the current French FAPs consumption pattern can be considered unsustainable from both an environmental and health point of view. Several levers are presented to guide French consumers towards more sustainable behaviour. Firstly, by integrating the environmental dimension into existing initiatives that promote the consumption of FAPs. Secondly, by promoting the consumption of underexploited species, particularly those landed by French fisheries. Finally, the importance of educating the younger generation to adopt more sustainable behaviour, particularly through school education, is also discussed.

In this sense, labels can also be a useful tool to guide consumers towards more sustainable behaviour. However, these initiatives are increasingly present in the FAPs market, leading consumers into trade-off situations. This thesis provides interesting findings on how consumers position themselves in relation to the different alternatives present in the FAPs market. Using a multiple choice approach, this thesis shows that French consumers' preferences for labelled FAPs are highly heterogeneous and remain driven by “self-oriented” motivations. They show that French consumers have a strong preference for labels that guarantee the domestic origin of FAPs. Preferences linked to “ethical” labels (notably ecolabels and animal welfare) remain secondary. It is necessary to strengthen this ethical demand in order to ensure a more sustainable consumption of FAPs. In this sense, our results show that younger generations represent an interesting target segment. This work also shows that coastal residents have specific preferences compared to non-coastal residents. They tend to prefer “local origin” labels rather than ecolabels. Local labels can therefore be an opportunity to promote FAP consumption in coastal areas, but they need to include clear environmental considerations in their criteria.

Given these heterogeneous preferences for labelled FAPs, multi-labelled FAPs offer an interesting lever to guide consumer behaviour. However, works on this topic are scarce in the FAPs value chain.T his thesis aims to fill this gap, and is interested in consumers' WTP for ecolabels, safety claims and these two labels combined on

the same FAPs. Furthermore, it aims to measure the influence of the production methods (wild vs farmed on this stated WTP. Globally, we find that consumers tend to value more the ecolabels on wild species, and more the safety claims on farmed species. This result highlights that the production method can influence our consumers WTP. Regarding double-labelled FAPs, our results highlight that adding a second label does not always increase consumers WTP. If the first label present on the FAP provides information about the attributes that consumers value most (environmental information for wild species and safety information for farmed species), adding a second label leads to a decreasing marginal WTP. In this case, a unique label is perceived by consumers as more efficient than combined labels. This finding highlights the potential risks of developing communication and information messages around multiple attributes on the same products.

Finally, this work is interested in measuring the potential influence of the place of residence on consumers preferences and knowledge regarding the FAPs sector. It demonstates that coastal consumers are more interested than non-coastal consumers in the origin of their FAPs, and also in the environmental impact of their FAPs. More than that, coastal consumers have a higher level of knowledge about the FAPs sector than non-coastal consumers. Proximity to the place of production seems to facilitate access to information for coastal consumers, in line with the theory of territorial knowledge dynamics. This difference in knowledge can partly explain why these consumers have different preferences and also different behaviours compared to non-coastal households.

# Scientific production

## Publications

Accepted for publication

**Dewals Jean-François, Le Floc'h Pascal, Daures Fabienne, Lucas Sterenn.** (2024). "La place des consommateurs dans les dynamiques territoriales de connaissance : le cas des produits de la mer". *Revue d'économie régionale et urbaine*. Septembre (Translated in English)

**Dewals Jean-François, Lucas Sterenn, Daures Fabienne, Le Floc'h Pascal.** (2024). "Assessment of consumer preferences in the context of multiple labels: the case of Fishery and Aquaculture Products". *Review of Agricultural, Food and Environmental Studies.*

Submitted

**Dewals Jean-François, Lucas Sterenn, Daures Fabienne, Le Floc'h Pascal.** (2024). "How do production methods affect consumer WTP for single and double-labelled seafood?". (In review) *Food Policy*.

**Dewals Jean-François, Daures Fabienne, Le Floc'h Pascal.** (2024). "The role of fisheries and aquaculture products in ensuring sustainable food consumption". (In press)

## Communications in international conferences and workshops

**Dewals Jean-François.** (2021) "Consumers preferences regarding labelled FAPs in France". XXV Congress of the European Association of Fisheries Economists (EAFE). (Online)

**Dewals Jean-François.** (2022) "Assessment of consumer preferences in a context of multiple labels: the case of fishery and aquaculture products (FAPs)". XX Congress of the International Institute of Fisheries Economics & Trade (IIFET). Vigo, Spain.

**Dewals Jean-François.** (2023) "Consumer WTP for single and double labelled seafood products, the case of health claims and ecolabels". XXVI Congress of the European Association of Fisheries Economists (EAFE). Athens, Greece.

**Dewals Jean-François.** (2023) "Assessment of consumer preferences in a context of multiple labels: the case of fishery and aquaculture products (FAPs)". XVII Congress of the European Association of Agricultural Economists (EAAE). Rennes, France.

**Dewals Jean-François.** (2024) "How do production methods affect consumer WTP for single and double-labelled FAPs?". XXI Congress of the International Institute of Fisheries Economics & Trade (IIFET). Penang, Malaisia.

# Other research and teaching activities

## Participation in research programme

Participation in several working groups of the FORESEA 2050 programme, which aims to integrate knowledge from different disciplines at different scales to develop scenarios for sustainable fisheries in France by 2050 in the context of global change by using a prospective approach. To have more information: https://foresea2050.ifremer.fr/

Report and publication

**Dewals Jean-François, Daures Fabienne** (2023). "Motivations passées, présentes et futures des consommateurs de produits de la pêche et de l'aquaculture"**.** Livrable Tâche 1.3 du projet FORESEA 2050, Ifremer/RBE/EM - UMR AMURE: 59p. https://doi.org/10.13155/96599

**Doray Mathieu, Chevallier Adrien, Daures Fabienne, Ernande Bruno, Girardin Raphael, Halouani Ghassen, Lapègue Sylvie, Lehuta Sigrid, Pernet Fabrice, Petitgas Pierre, Travers-Trolet Morgane, Dewals Jean François, Moullec Fabien, Lacroix Denis** (2023). "Quelle mer nourricière en 2050? Scénarios prospectifs pour la pêche et l'aquaculture en France". Ref. projet Foresea 2050. https://archimer.ifremer.fr/doc/00875/98709/c

## Contribution to a call for action under the One Ocean Summit held in Brest in February 2022.

Ahead of this international event organised by the French government to discuss the future of the oceans with over 100 countries and stakeholders from the ocean world, a call for action was elaborated by early carreer researches to raise awareness on the future challenges related to the ocean according to them. This call for action is available at : https://www-iuem.univ-brest.fr/one-ocean-university-at-unoc/

## Teaching assignments for various training courses

- 2021 - "**Science and society**" course – Master' degree – European Institute for Marine Studies – Plouzané, France.
- 2022 – "**Economics of the fisheries sector**" course – Bachelor's degree – University Institute of Technology – Quimper, France.
- 2022 - "**Consumption of FAPs**" intervention - Master' degree - Engineering School "L'institut Agro" – Rennes, France
- 2024 – Graduate Assitant at the University of Western Britanny – Brest, France
    - "**Academic working methodology**" - Bachelor's degree
    - "**Economic financing**" - Bachelor's degree

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|---|---|
| AIC | Akaike Information Criteria |
| ANSES | French National Agency for Food, Environment and Health |
| ASC | Aquaculture Stewarship Council |
| BIC | Bayesian Information Criteria |
| CAP | Common Agricultural Policy |
| CFP | Common Fisheries Policy |
| DBCM | Double-Bounded Dichotomous Choice |
| EAFE | European Association of Fisheries Economists |
| EC | European Commission |
| EU | European Union |
| EEZ | Economic Exclusive Zone |
| EII | Environmental Impact Index |
| EUMOFA | European Market Observatory for Fisheries and Aquaculture Products |
| FAO | Food and Agriculture Organisation |
| FAP(s) | Fishery And Aquaculture Products |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gases |
| HLPE | The High Level Panel of Experts on Food Security and Nutrition |
| IAA | Irrelevant Alternatives aAsumption |
| ICES | International Council for the Exploration of the Sea |
| IFREMER | French National Institute for Ocean Science and Technology |
| INSEE | French National Institute for Statistical and Economic Studies |
| IPBES | Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services |
| MLM | Multinomial Logit Model |
| MMNL | Mixed Multinomial Logit model |
| MSC | Marine Stewardship Council |
| NGO | Non Governmental Organization |
| NQI | Nutritional Quality Index |
| OIE | World Organisation for Animal Health |
| PCBs | Polyhlorinated Biphenyls |
| PCDDs | Polychlorinated Dibenzo-p-Dioxins |
| PCE | Perceived Consumer Effectiveness |
| PGI | Protected Geographical Indication |
| PNA | National Food Programme |
| RCN | Research Council of Norway |

| | |
|---|---|
| SSF | Small-Scale Fisheries |
| SDGs | Sustainable Development Goals |
| STECF | Scientific, Technical and Economic support to the Common Fisheries Policy |
| TACs | Total Allowable Catches |
| UN | United Nations |
| UNCTAD | United Nations Conference on Trade and Development |
| UNEP | United Nation Environment Programme |
| WHO | World Health Organisation |
| WTP | Willingness To Pay |
| WWF | World Wildlife Fund |

# General Introduction

*"Beyond the biological function of maintaining health, food connects us to ourselves, to others and to the biosphere."*

**From "La Terre au carré"**

*"When we think about threats to the environment, we tend to picture cars and smokestacks, not dinner. But the truth is our need for food poses one of the biggest dangers to the planet".*

**From "A five-step plan to feed the world" - National Geographic**

## 0.1 - The current situation of food systems

With the world's population expected to reach 10 billion by 2050 (according to the United Nations (UN) projections[1]), one of the major challenges of tomorrow is how to feed humanity without jeopardising the future of our planet. To respond to this major issue, public food policies, whether international or regional, are currently structured around a notion that has gained ground in public debate since the 1990s: food systems (UNEP, 2016). The European Commission (EC), the UN and the Food and Agriculture Organisation (FAO) define food systems as "*the entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption, and disposal (loss or waste) of food products that originate from agriculture (incl. livestock), forestry, fisheries, and food industries, and the broader economic, societal, and natural environments in which they are embedded*". These food systems are various and complex entities operating at different geographical scales, on which different drivers, dimensions, value chains, food environments, governance systems and actors interact (Figure 0.1). However, in the face of many current and future challenges (climate change, natural disasters, wars, energy dependency, water scarcity, population growth, etc.), the global food system's ability to provide affordable and quality food for the growing world population is being seriously questioned (Willett *et al.*, 2019; Béné *et al.*, 2019; FAO, 2023a).

On the one hand, food systems come under scrutiny due to their environmental impacts (Béné *et al.*, 2019). At the global scale, Gephart *et al.* (2021) and Crippa *et al.* (2021) state that they are responsible for a quarter to a third of our total greenhouse gas (GHG) emissions. Furthermore, they are one of the leading drivers of biodiversity loss and strongly participate in water scarcity, eutrophication, soil depletion, the depletion of renewable resources (forests, fish, etc.), land use conflicts, etc. (Poore and Nemecek, 2018). In order to meet the European Union (EU) targets set out in the European Green Deal, such as carbon neutrality by 2050 or decoupling economic growth from resource use, it is necessary to reconsider current practices.

On the other hand, food systems are also criticised with regard to public health issues. Worldwide, there is major concern regarding malnutrition. According to the latest FAO report (FAO, 2023a), this affects 9.2% of the world's population, predominantly in developing countries. In developed countries, the issues are more related to the quality of food and nutrition and their impact on public health. The EU Commission states that "*It is estimated that in the EU in 2017 over 950,000 deaths (one out of five) and over 16 million lost healthy life years were attributable to unhealthy diets, mainly cardiovascular diseases and cancers*"[2]. In addition, the food sector faces

[1] To have more information on this estimation: https://www.un.org/en/global-issues/population
[2] From the "From Farm to Fork" strategic document: https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

recurrent major food crises (mad cow disease, *Salmonella*, *Listeria*, biological contamination, etc.), which result in global mistrust from civil society, particularly with regard to industrial production. Although the sustainability of food systems is frequently discussed in terms of environmental and health concerns, these issues are inextricably linked to broader questions of governance, equity, socio-economic outcomes, and so forth (UNEP, 2016).

According to the FAO (FAO, 2023b), the "hidden costs" of agrifood systems' are estimated to be 12,749 billion euros, more than 10% of the global Gross Domestic Product (GDP)! As stated by the UN Conference on Trade and Development (UNCTAD), there is a need for a "paradigm shift". Consequently, there is a strong commitment to promote more sustainable ways of producing and consuming food worldwide. The Sustainable Development Goals (SDGs), adopted by the UN in 2015, reflect this international ambition. However, because food systems are complex entities, reforming them is often difficult and requires a comprehensive, holistic and long-term vision. Moreover, as evidenced by the recent global crisis (the COVID-19 pandemic and the war in Ukraine, among others), these food systems are confronted with considerable uncertainties (FAO, 2023a). Consequently, a more comprehensive understanding of these food systems is a pivotal step towards making them more sustainable and resilient, thereby ensuring a successful dietary transition.

Regarding food system sustainability, it is generally accepted that the environment and health spheres are inextricably linked through spill-over effects (Crona *et al.*, 2023), and that both issues must be tackled together (Macdiarmid *et al.*, 2012; Tigchelaar *et al.*, 2022). It therefore becomes complicated to think about public policy without considering the global implications it may have on the other dimension, underlining this need for holistic policies. Along these lines, the EU's food policy, the "From Farm to Fork" strategy, "*recognises the inextricable links between healthy people, healthy societies and a healthy planet*". This explains why the concepts of "healthier and sustainable diets" or "healthy and sustainable" food systems lie at the heart of public and private initiatives (Willett *et al.*, 2019).

Nevertheless, although this willingness to reform our food system is becoming prevalent, the objectives are still far from being achieved (FAO, 2023a). Negative environmental and social externalities are constantly increasing, including in developed countries. Policymakers are faced with a complex issue, and a "win-win" scenario (including both human and environmental health) may indeed be difficult to achieve (Béné *et al.*, 2019). To reach the objectives of "sustainable and healthy" food systems, long-term policies still need to be developed and promoted. These policies must involve all the stakeholders in these production systems, including a very specific one: the consumers. Indeed, as highlighted in Figure 0.1, consumers play a central role in our food systems. As citizens, they are directly subject to the costs of the externalities generated by our food systems, and as consumers, their consumption choices and behaviours can influence the future of these food systems. As Figure 0.1 shows, public policies and institutions are interesting levers to influence these choices and behaviours.

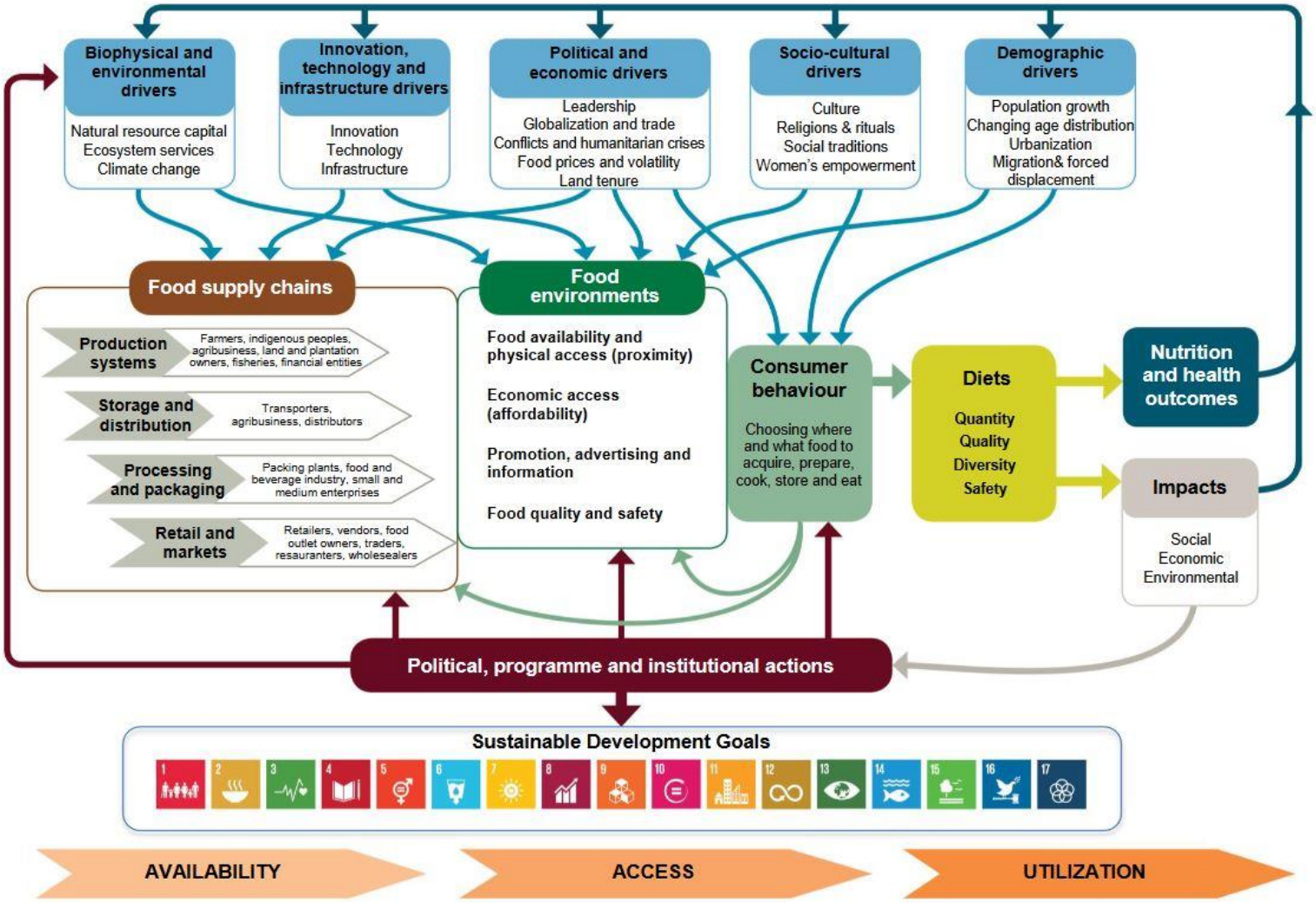


**Figure 0.1 - Representation of food systems**
Source - From The High Level Panel of Experts on Food Security and Nutrition (HLPE) (2017)

## 0.2 - The consumers' place in this dietary transition

Historically, policies aimed at reforming food systems have focused primarily on the productive sphere. However, since the concept of "sustainable consumption and production" was generalised in the "Agenda 21" in 1992, there has been growing awareness that the transition of food systems needs to be considered from the upstream part of the chain to its downstream components. The perceived role of citizens has slowly evolved. They are gradually moving from a position of "decision takers", without real influence on the upstream part of the value chain, to being perceived as "decision makers", whose consumption choices can influence the whole chain (Verbeke, 2005) and drive food sectors towards greater sustainability (Teixeira *et al.*, 2024). As the EU Food Policy Coalition states: "*Food demand patterns are an outcome of food systems, but can also be important levers of change*" (EU Food Policy Coalition, 2021). As discussed by Bouchery (2016), it is recognised that consumer behaviour and the supply chain are the two broad areas that can be worked on to achieve more sustainable outcomes.

The involvement of consumers as key actors in the transformation of food systems is discussed in particular through the prism of the information given to them. Sustainability is a multidimensional concept about which consumers are still confused (Teixeira *et al.*, 2024). Consequently, it is necessary to inform and educate them about this polysemous concept. As Weinstein (1988) points out, information is linked to knowledge and knowledge to behaviour. In contrast to more prescriptive/mandatory approaches, aimed more at the productive sphere, better information for consumers is more about enabling them to make informed choices and guiding them towards sustainable consumption choices. Thus, the strategic document of the "From Farm to Fork" strategy, for instance, identifies the following objective: "*Providing consumers with clear information that helps them make healthy and sustainable food choices will improve their health and quality of life and reduce health-related costs*". Public authorities have various methods for informing consumers (Mass media campaigns, food education, health professionals, etc.). Among these methods, food labelling has gained popularity in the food market in recent decades. At the EU level, EU Regulation No 1169/2011, adopted in 2011, and the new EU Regulation No 1143/2024, adopted in 2024, set out guidelines for labelling information on food products. This work discusses the role of these labels in guiding consumers towards more sustainable behaviour.

## 0.3 - Labels in the food sector

Over the years, food labelling has become an integral part of consumers' daily lives. The FAO uses the following definition for food labelling: "*it includes any written, printed or graphic matter that is present on the label, accompanies the food, or is displayed near the food, including that for the purpose of promoting its sale or disposal*[3]". This "broad" definition accurately reflects the complexity of labelling and related

[3] Definition from the FAO Codex Alimentarius

issues.

### 0.3.1 - Theory of labelling in the food sector

This thesis is situated within the field of consumer economics, with a particular focus on Lancaster's New Consumer Theory (Lancaster, 1966). Before Lancaster, the neoclassical view was that the utility a consumer derives from a good depends on the good "as a good". For Lancaster, the utility derived from a good depends on the presence or absence of characteristics in the product (price, colour, packaging, etc.), qualified as attributes. Following Lancaster's approach, Nelson (1970) defined two types of attributes. The first are the search attributes. The consumer can determine their presence before consuming the good (e.g., price, colour). For these attributes, the marginal cost of seeking this information is inferior to the associated benefits before consuming the good. The second are the experience attributes. The consumer cannot determine their presence before consumption, but only after it (e.g., taste). For these attributes, the marginal cost of seeking this information is less than the associated benefits after consuming the good. This vision was completed by Darby and Karni (1973). They discussed the role of credence attributes. Consumers cannot verify the presence of these attributes in products before or after good consumption (e.g., nutritional content, environmentally friendly production, etc.). The only way to obtain this information is through a long and costly research process. In this case, the marginal cost of searching for this information is higher than the associated benefits, before and even after consuming the good.

The existence of these credence attributes can be problematic from a market equilibrium perspective. Indeed, consumers have no guarantee that these attributes are present in their products. This leads to a market distortion, qualified by Akerlof as asymmetric information (Akerlof, 1970) and results in explicit costs or implicit costs (e.g. Moral hazard and adverse selection) (Roe *et al.*, 2014). To limit this distortion, labels have emerged as a viable alternative. Labels must "*convey information about both objective and subjective food characteristics*" (Caswell and Padberg, 1992). Their purpose is to transform "credence" attributes into "search" attributes (Caswell and Mojduszka, 1996), to reduce this asymmetric information between consumers and producers.

However, the characteristics of labels vary considerably. One essential distinction can be made between "mandatory" and "voluntary" labels, which is discussed in detail in the article by Roe *et al.* (2014). For voluntary labels, the producer elects to comply with a set of specifications, including different criteria, in order to display the label on products. Unlike mandatory labels, there is no legal requirement to display this type of label; it depends on the will of the manufacturer. However, the certification criteria and the way in which these labels are certified can vary, resulting in more or less restrictive alternatives regarding the attributes they defend. Third-party certification is often regarded as the most restrictive system and, as a result, the most trustworthy initiative (Lucas *et al.*, 2021), including for consumers (Roe *et al.*, 2014). These voluntary labels are at the heart of this work.

From the perspective of the producers, voluntary labels serve as a means of informing consumers about a specific characteristic of their production. Such schemes enable differentiating one's production from that of competitors (Caswell and Padberg, 1992), thereby facilitating access to new markets. Nevertheless, participation

in a voluntary labelling process is frequently associated with additional costs linked to a change in practices (Chikudza *et al.*, 2020). These can include monitoring, traceability, and the use of new materials, among other factors. In return, producers anticipate that they will be able to recoup their investment in the form of a "price premium". Without this incentive, the motivation for producers to adopt voluntary schemes is limited, as it could threaten the viability of their business.

### 0.3.2 - Development, preferences, and limitations of existing labelling schemes

When purchasing, consumers first tend to pay attention to information such as price, quantity, brand, ingredients list, etc. (Grunert *et al.*, 2014, Richter *et al.*, 2017). Nevertheless, their interest regarding credence attributes is also important. Indeed, consumers seek information about the quality of their food (Salaün and Flores, 2001; Verbeke and Ward, 2006), the safety aspects (Ortega *et al.*, 2011, Bjorndal *et al.*, 2014), the environmental impacts (Grunert, 2011; Grunert *et al.*, 2014), respect for animal welfare (Vanhonacker and Verbeke, 2014; Clark *et al.*, 2017), the origin (Feldmann and Hamm, 2015), etc. In response, a diversity of voluntary labels has expanded in the food sector and coexists today (Asioli *et al.*, 2020). A study funded by the European Union in 2013[4] found that 900 voluntary labels were being applied in the EU food sector. We can assume that this number is even higher today. Consumers tend to perceive labels as a reliable source of information (Fonner and Sylvia, 2015) and have a positive opinion of them (Pieniak *et al.*, 2007). Nevertheless, consumer preferences for food labels are highly heterogeneous, as demonstrated by Gracia and De-Magistris (2016).

The existing literature frequently examines the impact of socio-demographic characteristics (e.g., age, gender, income, education, and residence) on label preferences (McCluskey and Loureiro, 2003; Chen *et al.*, 2015; Gracia and De-Magistris, 2016). What is more, other factors also influence preferences, including psychological characteristics such as values, personal experiences, perceptions, involvement, beliefs, norms, attitudes and motivations (de Boer *et al.*, 2007; Apostolidis *et al.*, 2019; Mazzocchi *et al.*, 2021). Contextual factors (Cubero Dudinskaya *et al.*, 2021; Feldmann and Hamm, 2015) and knowledge (Olsen, 2008) have also been identified as determining levers of observed preferences. The observed heterogeneity in consumer preferences for labelled foods in the existing literature is thus explained by the variety of the aforementioned factors. Consequently, understanding the underlying structure of this heterogeneity is essential for implementing effective labelling initiatives.

Nevertheless, despite a generally positive global perception of labels, their expansion in the food sector also results in negative externalities. Indeed, today, a "plethora" of labels coexist within the food market (Santeramo *et al.*, 2018). The quick development of these labels leads to some "overlapping" of existing approaches and the emergence of "dubious" labels on the market. From the consumer's perspective, it can be challenging to differentiate between these labels (Janßen and Langen, 2017), as they often lack the requisite level of knowledge and/or information. This results in a global confusion among consumers, a perceived loss of quality in labels,

[4] From "Consumer market Study on the functioning of voluntary food labelling schemes for consumers in the European Union" EAHC/ FWC/2012 86 04 - IPSOS for EU commission.

and increasing distrust in these initiatives (Verbeke, 2005; Sonntag *et al.*, 2023). In addition, the effectiveness of labelling policies is still questioned, notably their ability to modify demand structurally. Indeed, according to Pieniak *et al.* (2007), "*studies have shown that food labels may be of little use because lack of knowledge and low ability to perform simple inference-making leads to failure in decoding the information*". Not only does criticism occur on the demand side, it is also evident among other stakeholders in the value chain, notably nongovernmental organisations (NGOs) and consumer organisations. While labels are an integral part of our public policy and offer significant benefits, they must be better designed in order to go beyond the abovementioned limitations.

## 0.4 - Fishery and Aquaculture Products (FAPs); a new Eldora?

Changing food consumption patterns in developed countries is a key lever that must be employed if we are to pave the way for more sustainable food systems. Indeed, current patterns are unsustainable, with a notable contribution from excessive meat consumption (Rust *et al.,* 2020; Kwasny *et al.,* 2022). Meat production and consumption are highly criticised for their impact on the environment, biodiversity, land use, and water use. According to Poore and Nemecek (2018), animal products account for 56 % of global GHG emissions from the food sector. Furthermore, several studies have indicated that a diet excessively rich in meat can also significantly impact human health (Rust *et al.,* 2020). Consequently, reducing meat consumption is an essential step towards achieving the goals of sustainable food systems. As discussed by Perignon *et al.* (2017), the choice of substitute products is essential, as they also have their own specificities, particularly in terms of their environmental and/or health impact. Vegetarian diets are generally promoted as a viable alternative (Perignon *et al.,* 2017; Vieux *et al.,* 2018; Springmann, 2020; Rust *et al.,* 2020). According to Willet *et al.* (2019), they have the lowest environmental impact compared to their nutritional content. Nevertheless, vegetarian diets are not without their detractors (Pilis *et al.,* 2014) and may also encounter consumer resistance. That is why mixed diets can be a more promising alternative. In phase with this,Szocertain other food categories can also present advantages, including one of particular interest for this work: Fishery and Aquaculture Products (FAPs).

### 0.4.1 - FAPs; advantages and current limits

In terms of availability, the production of FAPs has increased steadily since the 1980s. According to the FAO (2022), the global production of FAPs was about 177.8 million tonnes of live weight equivalent in 2020. This production is divided into two main production methods: wild species and farmed species. At present, these two production methods account for approximately 50% of the world's production (FAO, 2022). Nevertheless, despite the potential of FAPs as an alternative to meat consumption, they also present major limitations in terms of aligning with the principles of a "sustainable and healthy" diet.

### 0.4.2 - The health aspect of FAPs

FAPs are considered as healthy products. Although known for their protein content and their omega-3 fatty acids, they are also naturally rich in omega-6 fatty acids, calcium, sodium, iodine, selenium, iron and vitamins (B6, B12, D) (Golden *et al.,* 2021). These nutrients have been demonstrated to be beneficial in the prevention of a number of diseases, including cardiovascular disease, obesity and diabetes (Brunsø *et al.,* 2008). They are also

essential for the improvement of certain human body functions. Consequently, their consumption is promoted on an international scale, notably in countries where these illnesses are becoming increasingly common. For instance, EU member states promote their consumption through nutritional recommendations[5]. The recommendations vary from country to country, with an average of approximately two servings per week.

However, questions have been raised about the health attributes of FAPs. Indeed, FAP consumption may expose consumers to environmental contaminants such as polychlorinated biphenyls (PCBs), methylmercury, dioxins or even polychlorinated dibenzo-p-dioxins (PCDDs) (Jacobs *et al.*, 2015; Govzman *et al.*, 2021). The use of hormones and antibiotics is also problematic in the aquaculture sector (Birch and Lawley, 2012). These chemical elements are directly linked to adverse effects on human health, especially in vulnerable populations, and can constitute a barrier to their consumption. However, this negative perception remains outweighed by the "healthy side" of FAPs, notably from the consumers' perspective (Brunsø *et al.*, 2008; Pieniak *et al.*, 2010).

### 0.4.3 - The environmental aspects of FAPs

Compared to meat production, FAPs are also interesting regarding environmental issues. According to Gephart *et al.* (2021), they "*have great potential for reducing food system environmental stressors*". Indeed, FAPs are described as having limited environmental impacts (Vieux *et al.*, 2018) and lower carbon emissions compared to meat production (Crona *et al.*, 2023). According to Irz *et al.* (2018), a fish-based diet produces less $CO_2$ than a meat-based diet. Other environmental advantages compared to land-based agricultural production are reduced land and freshwater use for wild production (less true for aquaculture) and limited P and N emissions (Gephart *et al.*, 2021). Nevertheless, the environmental impact is highly dependent on the production method and the species considered (Hilborn *et al.*, 2018; Hallström *et al.*, 2019; Ziegler *et al.*, 2019; Gephart *et al.*, 2021). Small pelagic species, algae and bivalves (low-trophic species) are frequently considered promising products from an environmental standpoint (Hallström *et al.*, 2019; Koehn *et al.*, 2022).

However, FAPs are also well known for their impact on the environment. These impacts are highly diversified (Gephart *et al.*, 2021) and, again, depend on the production method. The most apparent consequence is the overexploitation of wild resources. According to the FAO (FAO, 2022), 35.4% of the world's wild stocks were exploited at unsustainable levels in 2019. This percentage has been rising since the 1970s and fishing capacity has increased. In addition, the impacts often go beyond the target species and include damage to the seabed, damage to the food web, discards, by-catches, catches of mammals and seabirds, etc. The rapid development of aquaculture production (the fastest growing food sector since the 1990s (Claret *et al.*, 2014; Gephart *et al.*, 2021)) is also causing impacts on ecosystems (Almeida *et al.*, 2015; Maesano *et al.*, 2020). Indeed, aquaculture relies on wild production, especially for omnivorous species (Almeida *et al.*, 2015). It also affects ecosystems through land use, pollution, eutrophication, genetic contamination, etc. (Gephart *et al.*, 2021).

[5] To obtain precise information on these recommendations go to: https://knowledge4policy.ec.europa.eu/health-promotion-knowledge-gateway/food-based-dietary-guidelines-europe-table-9_en

Finally, according to the FAO (FAO, 2022), FAPs are one of the most traded commodities in the world. Approximately 45% of the world's production of FAPs is traded internationally, with an estimated value of $143 billion (FAO, 2022). These exchanges also have important environmental implications, particularly in terms of GHG emissions.

Although FAP has some advantages over meat production, once again, it is not a “silver bullet”. There is therefore a real need to change the way FAPs are produced and consumed in order to move the sector towards greater sustainability.

## 0.5 - Moving the FAP sector towards greater sustainability

### 0.5.1 - International commitment to reform the sector

With regard to the externalities mentioned previously, there is an international commitment to reform the FAP sector. The Common Fisheries Policy (CFP), which was introduced in 1983, reflects this ambition at the EU level. The role of consumer information is central to this policy, with citizens often unaware of the characteristics of this particular sector. Since 2014, the EU has introduced a specific legislation on the mandatory information to be provided on FAPs circulating on the EU market[6]. This includes information on the name of the species, production methods, fishing gear, etc. In addition to regulatory measures, voluntary labelling has also expanded rapidly in the sector, driven notably by consumer demand.

### 0.5.2 - Voluntary labels in the FAP sector

Although labels are not the primary criterion for selecting FAPs (compared to price, habits, freshness, etc.) (Richter *et al.*, 2017; Zander *et al.*, 2018), again consumers express a strong interest in obtaining information about the credence attributes of their FAPs. In a highly globalised and integrated food market, characterised by significant traceability issues (Crona *et al.*, 2016), and where consumers have limited knowledge about these products (Menozzi *et al.*, 2023), voluntary labels have emerged as an effective means of communicating information to consumers, notably about these credence attributes.

Indeed, FAP consumers express a strong interest in the origin of their products (Jaffry *et al.*, 2004; Claret *et al.*, 2012; Uchida *et al.*, 2014). Widespread awareness of the environmental impact of fishing has given rise to green demand (Brécard *et al*, 2009; Salladarré *et al.*, 2010), explaining why environmental claims are increasing in the EU market (Lucas *et al.*, 2021). Animal welfare is also a growing consumer concern (Clark *et al.*, 2017). Although this issue is often associated with aquaculture production, it is increasingly being questioned regarding the wild sector (Waley *et al.*, 2021). Consumers are also starting to express interest for additional information regarding the heathy attributes of FAPs, notably for aquaculture products (Banovic *et al.*, 2019). This market provides an interesting case study for exploring consumers' different expectations and needs for information about the food they consume, and how labelling can provide opportunities to guide consumers towards sustainable

[6] To have more information about this specific legislation : https://oceans-and-fisheries.ec.europa.eu/system/files/2016-09/eu-new-fish-and-aquaculture-consumer-labels-pocket-guide_en.pdf

behaviour.

A plethora of studies have examined consumer preferences for ecolabelled FAPs (Johnston *et al.*, 2001; Brécard *et al.*, 2009; Roheim *et al.*, 2011; Brécard *et al.*, 2012; Uchida *et al.*, 2014; Asche *et al.*, 2015; Bronnman and Asche., 2017; Weitzman and Bailey, 2018; Menozzi *et al.*, 2020; Winson *et al.*, 2021). Although the methodologies employed are diverse (contingent valuation method, discrete choice method, in situ observation, etc.), they collectively reveal heterogeneity in consumer preferences for these labels. Additionally, a substantial body of research has been conducted on consumer preferences regarding the origin attributes of their FAPs (Claret *et al.*, 2012; Uchida *et al.*, 2014; Sogn-Grundvåg *et al.*, 2014; Zander and Feucht, 2018; Banovic *et al.*, 2019; Zander *et al.*, 2022). Again, although the methodologies employed vary (focus group, contingent valuation method, etc.), these studies demonstrate that consumers express a preference for domestic products over imported ones. While the existing literature has investigated consumer perceptions of the health aspects of FAPs (Verbeke *et al.*, 2005; Pieniak *et al.*, 2008; Pieniak *et al.*, 2010; Jacobs *et al.*, 2015), articles on consumer preferences for their associated labels appear to be scarce (Brécard *et al.*, 2012; Banovic *et al.*, 2019; Menozzi *et al.*, 2020). However, these few works have highlighted that consumers are interested in these labels. Some studies have also looked at preferences for animal welfare (mainly for farmed seafood) (Alfnes *et al.*, 2018 ;Sonntag *et al.*, 2023) or fair trade labels (Brécard *et al.*, 2012).

## 0.6 - Scope of the PhD thesis

### 0.6.1 - Global context and research questions

While there are numerous works regarding consumer preferences for labelled FAPs, the issue of sustainability is often addressed through the prism of ecolabelling. However, the sustainability of FAP systems needs to be understood in a more multidimensional way. This thesis, therefore, aims to go beyond the existing literature by exploring sustainability in a "broader sense". In response to the global objectives of "sustainable and healthy food systems", particular attention is paid to environmental and health dimensions in the FAP sector. In this work, the environmental dimension is studied in its large sense, from the conservation of exploited species to the issue of GHG emissions. The health dimension is approached through the prism of the safety of the FAPs offered to consumers, in the face of increasing questions from consumers on this specific aspect. This work also seeks to link this concept of sustainability with the dimension of "local consumption"[7]. This dimension has direct implications for the economic benefits of a territory. Animal welfare and fair-trade dimensions have also been included as they are also directly linked to sustainability issues in food systems. These different dimensions of sustainability are discussed in this thesis through the prism of consumer preferences for labelled FAPs. In this sense, this thesis is an extension of existing works, such as that of Brécard *et al.* (2012), which have already dealt with consumer preferences for multiple labels in a framework of "sustanaible consumption". Nevertheless, this work will take an even broader view of the issue.

[7] Studying this dimension is even more interesting in a global context of inflation, as the FranceAgriMer (2022a) shows that consumers are moving away from ecolabels in favour of local labels.

**The main objective of this thesis is to propose recommendations/levers to guide FAP consumers towards more sustainable consumption behaviours in order to achieve greater sustainability in the sector, with a particular focus on the role of voluntary labels in facilitating this transition. The case study used in this thesis is the French market (see section 1.7).**

Several sub-objectives are inherent in this research question:

1. The first objective of this thesis is to gain a deeper understanding of the consumption patterns of FAPs in France.
2. The second objective of this work is to better study consumer preferences for different labels that coexist on the french FAP market.
3. The third objective of this work is to provide new insights into consumer valuation of multi-labelling initiatives in the FAP sector.

***Research question 1: To what extent are French FAP consumption patterns currently structured around the objectives of sustainable and healthy diets (chapters 1 & 2)?***

Indeed, the existing data inside the French market are often limited in their ability to explain consumption behaviour at the individual scale, limiting our understanding of some of the ongoing trends within this market. Improving our comprehension of the individual dynamics of FAP consumption thus appears to be of paramount importance before discussing consumers' positioning regarding labelled FAPs. This includes: (1) deeper understanding of the FAP consumption patterns in this market; (2) better understanding of the alignment between French FAP consumption and the global objectives of resource conservation and public health. This knowledge is an essential step in guiding consumers towards more sustainable behaviour.

***Research question 2: In a highly competitive label market, how are preferences structured with respect to different credence attributes and their associated labels (chapters 2 & 3 & 4)?***

Although labels have proved to be a promising tool for informing consumers, certain obstacles hinder their potential effectiveness. Among these limitations, one that is often highlighted is the proliferation of labels coexisting on the market. Indeed, these labels are associated with different credence attributes and compete with each other. Despite numerous works on consumer preferences for labelled FAPs, we still have limited knowledge of how the preferences for these different initiatives are positioned in relation to each other today. In order to promote the sustainable consumption of FAPs, it is necessary to better understand the trade-off consumers face when shopping (Fonner and Sylvia, 2015; Maesano *et al.*, 2019) and the consumption profiles associated with these stated preferences. While the existing literature is often interested in these consumption profiles in relation to a dichotomous position (preference expressed for labelled vs. unlabelled products), this thesis proposes to study these profiles in a less constrained choice situation, with a large pool of alternatives.

***Research question 3: How can specific initiatives such as multi-labelling offer a solution to guide consumers towards FAPs that are safe for health and environmentally sustainable (chapter 3)?***

In the context of significant competition between producers and the heterogeneity of consumer expectations, multi-labelled products are expanding in food markets (Dufeu *et al.*, 2014). The process of multi-labelling offers new opportunities for producers to provide consumers with an increasing amount of information, despite the absence of a global consensus on how consumers perceive and/or value these initiatives in the existing literature. While these initiatives have not yet penetrated the FAP sector, there is very little research on the subject (Uchida *et al.*, 2014; Fonner and Sylvia, 2015). This thesis attempts to fill this gap by examining the potential association between ecolabels and safety claims for the same FAPs. As consumers have differing expectations regarding farmed and wild seafood (López-Mas *et al.*, 2021), notably regarding the concept of sustainability (Zander and Feucht, 2018), this thesis is also interested in testing whether the production methods employed can influence consumers' valuation of these schemes.

In order to address the aforementioned research questions, this thesis is structured around four articles, which are summarised in the following section.

**0.6.2 - The contributions of the chapters**

The **first chapter** of this thesis is concerned with a more comprehensive understanding of the factors influencing the consumption of FAPs in the French market. Although some aggregate public data exist on this subject (average consumption, most consumed species, prices, etc.), they are not sufficient to assess the adequacy of the behaviour observed as a function the global objectives of resource preservation and public health. To fill this gap, this article proposes to cross three sources of data. First, in order to obtain an overview of the existing determinants of FAP consumption, we performed a literature review. Subsequently, we confronted these findings with the results of a consumption survey performed in 2023 on the French market. We used an ordered probit model to assess the influence of 20 explanatory variables (identified through the literature review) on reported FAP consumption frequencies. Our dependent variable measures this frequency in relation to three ordered modalities: “at least once a week”, “at least once a month”, and “less than once a month”. As we were also interested in consumer perceptions regarding wild and farmed species, means-comparison tests were also performed. Through our results, this article suggests levers to inform French consumers better and guide them towards more sustainable FAP consumption behaviours. It introduces, among other things, the necessity to better understand the positioning of French consumers regarding labelled FAPs. This specific issue is discussed more precisely in the next three chapters.

The **second chapter** of this thesis is interested in better understanding how the preferences towards the different labels that coexist within the French FAPs market are structured. Indeed, this market is profoundly affected by the proliferation of labels. These labels are often interested in one specific attribute, such as product quality, origin, production methods, animal welfare, etc., and compete with each other. Consequently, consumers are presented with a series of challenging trade-off situations when purchasing FAP products. However, we have

a limited understanding of how consumer preferences regarding these various labels are structured. While the existing literature has often focused on preferences expressed for a single or limited number of labels (Brécard *et al.*, 2009; Banovic *et al.*, 2019), no research has investigated these preferences for a wider range of labels.

To fill this gap, this article relies on a consumer survey conducted in 2021 on the French market, which included an innovative "multiple-choice approach". Indeed, the preferences for ten alternatives are studied simultaneously in this work. The alternatives were selected based on existing labels on the FAP market but also regarding global consumption trends in the food sector. Means comparisons tests were performed to statistically compare the preferences expressed, while a Mixed Multinomial Logit model (MMNL) with marginal effects was employed to study the consumption profiles behind these stated preferences. Explanatory variables related to consumers' socio-demographic characteristics, motivations, Perceived Consumer Effectiveness (PCE) and knowledge are included. Based on our findings, this article identifies several levers to guide French FAPs consumers towards more sustainable behaviours, notably through the implementation of more efficient labelling policies.

The **third chapter** of the thesis is dedicated to understanding consumers' Willingness To Pay (WTP) regarding ecolabels, safety claims, as well as their association with the same FAPs. We chose to work on these specific schemes as they are directly related to the global context of a "sustainable and healthy" diet and respond to consumer expectations regarding FAPs. Double-labelled products are becoming more common in the food market (Dufeu *et al.*, 2014) due to the current expansion of unique labels. However, no global consensus exists on their effect on consumers' utility and WTP in the existing literature. Furthermore, this literature is particularly scarce in the FAP sector. This literature is often limited to the interaction between a unique label and various product attributes. In our case, we want to test the interaction between two labels and various FAP attributes, notably the production method (wild vs farmed), based on our findings in **Chapter 1** and the existing literature (Zander and Feuch, 2018). Overall, this article aims to test three hypotheses: {H1} the WTP for the labels depends on the socio-demographic characteristics of consumers; {H2} the production method influences the stated WTP for these labels; {H3}: the WTP for double-labelled FAPs is higher than the WTP for single-labelled FAPs, but the marginal WTP decreases.

This article is based on a consumer survey conducted in 2023 on the French market. To measure consumers' WTP, we asked them to respond to a double-bounded dichotomous choice method. In this approach, consumers were asked to position themselves with respect to two dichotomous bids, where their response to the first one determines the level of the second one. We also gave them an "opt-out" option. A random effect probit model was then used to explore the consumer profiles underlying the reported WTP. This model included 21 explanatory variables related to price, knowledge, motivations, PCE, age, gender, place of residence, income and two variables related to bias (shifting and anchoring effects). Based on these results, this article discusses potential levers to improve the acceptance of both single and double-labelled FAP acceptance and their valuation by consumers.

The **fourth chapter** is more original in its approach, combining two specific fields of economics: consumption economics and regional sciences. This article proposes a new interpretation of the concept of territorial knowledge dynamics by including consumers in the triptych of industry, research and administration. The neglect of the role of consumers in these dynamics has been highlighted by Crevoisier and Jeannerat (2009) and addressed in more recent works (Jeannerat and Kebir, 2016; Martin *et al.*, 2019). To address this issue, we decided to focus our work on the FAP industry, an industry that can be perceived as being quite far from being innovative and knowledge-based. In this article, we seek to answer these two specific questions: Does the FAP industry exhibit the characteristics of a knowledge-based economy? Is this knowledge shared with consumers? We hypothesised that, due to their proximity to production sites, coastal consumers may possess different knowledge, and this knowledge gap can lead to differentiated preferences regarding labelled FAPs.

To do so, we used a consumer survey performed in 2021 in the French market. We split our global sample into two sub-samples: coastal consumers and non-coastal consumers. The department of residence serves as the reference point. Our samples are compared according to three entry points: consumers' preferences for FAPs (in general), their preferences expressed for three labels (ecolabels, France origin and local origin) and finally, their level of knowledge (objective, subjective, label and specific) of the FAP sector. This article opens the discussion on the place of consumers in these territorial knowledge dynamics and how these dynamics can influence their consumption behaviour.

## 0.7 - The case study: The French FAPs market

The empirical data used in this thesis come exclusively from the French market[8], one of the largest FAP markets within the EU (EUMOFA, 2022). Although this thesis focuses mainly on the consumption side, this section provides information on the importance of the whole sector for this country. Fishing is a historical activity of this territory (Le Floc'h, 2017), while aquaculture is also important but mainly focuses on shellfish. However, the economic impact of the sector is limited at the national scale. According to the French National Institute for Statistical and Economic Studies (INSEE), the fishing industry accounts for 1% of France's GDP. The interest of public policy in the sector is thus justified by the activity's historical and cultural aspects, its economic contribution to specific territories, and its contribution to the food supply.

### 0.7.1 - French FAP production

While Europe accounts for around 5% of world FAP production, France accounts for 14% of European production. With 649,000 tonnes of FAPs produced in 2020 (aquaculture accounts for about a quarter of this production), France is the third largest producer of FAPs within the EU (FranceAgriMer, 2023a). Figure 0.2 shows this relative production. Tuna (116,264 tonnes), oysters (80,943 tonnes) and mussels (66,445 tonnes) are the three species produced most. The total value of French production in 2020 was 1,939 million euros (FranceAgriMer, 2023a). Fresh and frozen landings are the main production method, accounting for three-

[8] FranceAgriMer provides more complete data on the structure of the French FAP market. To obtain more information: https://www.franceagrimer.fr/filiere-peche-et-aquaculture

quarters of this total.

In terms of production capacity, the French fleet is made up of 4,243 vessels (metropolitan only), 80% of which are less than 12 metres in length. Small-scale coastal fishing is therefore highly developed in France. Fishing generates 13,000 direct jobs. Trawlers make up a large part of the French fleet (FranceAgriMer, 2022b). Gillnetters, liners and seiners make up a smaller proportion. In addition, there are 3,088 aquaculture enterprises employing 11,332 full-time personnel (FranceAgriMer, 2022b). The downstream part of the industry is also highly developed, with wholesalers, processors and a large number of sales outlets, notably in coastal areas.

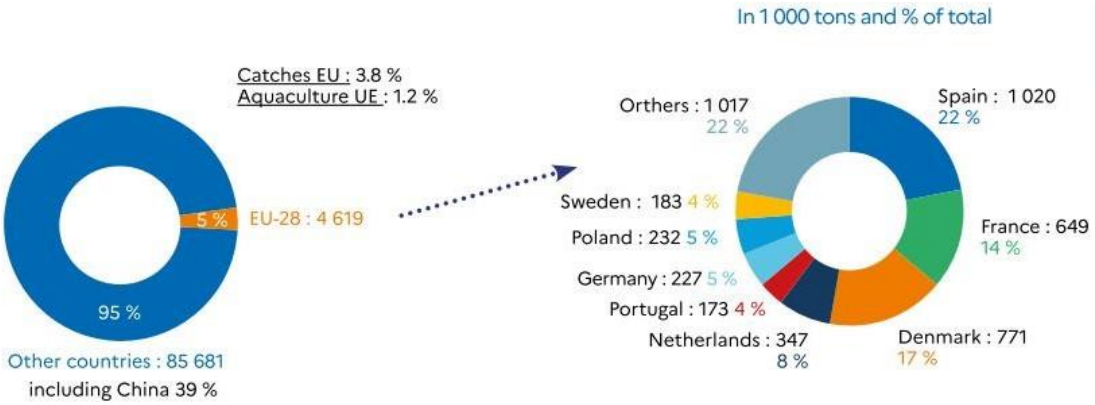


**Figure 0.2 - Size of French production regarding the world and EU production in 2020.**
Source - FranceAgriMer (2023a), data from the FAO

### 0.7.2 - The supply balance of the French FAPs market

Despite being a major producer, the French market is heavily dependent on imports. Indeed, France's trade balance for FAPs is significantly in deficit. In terms of value, in 2020, France imported 5,662 million euros of FAPs and exported 1,489 million euros of products. The net supply balance is thus - 4,336 million euros (FranceAgriMer, 2021). Globally, salmon represents the primary contributor to this deficit. In 2020, France imported 1,311 million euros of salmon. Shrimp, tuna and cod follow this with 765, 658 and 468 million euros, respectively. These imports are intended both for final consumption and for the processing industry, which is solidly established in the country. This explains why tuna, salmon and shrimp are also the most exported species, with values of 185, 178 and 139 million euros, respectively (FranceAgriMer, 2021).

### 0.7.3 - The French FAPs consumption

According to the FranceAgriMer report (FranceAgriMer, 2023b), the average annual per capita consumption of FAPs was 31.84 kg in 2021. Figure 0.3 shows the evolution of consumption between 1988 and 2017. It can be seen see that the consumption of FAPs increased in the 1990s, reaching a maximum of 34.2 kg per capita in 2006. Since the 2000s, the average consumption has been around 33 kg per capita. In the meantime, however, the French population has grown, which means that the global demand for FAPs has increased during this period.

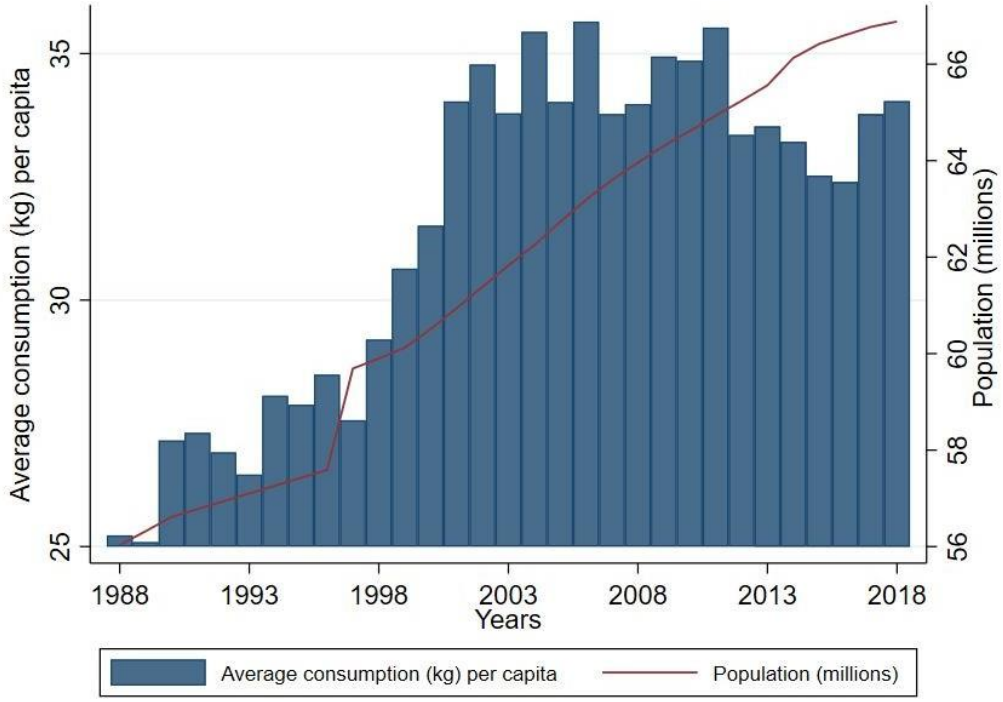


**Figure 0.3 - Average French FAP consumption between 1988 and 2018.**
Source - FORESEA 2050

The most consumed species are close to the main species consumed in the EU. These include salmon, tuna, Alaska pollock, shrimps and cod (FranceAgriMer, 2023b)[9]. These six species account for 57% of total French consumption, meaning that French FAP consumption is concentrated on a limited number of species. In terms of supply, most of these species are imported (FranceAgriMer, 2023b). A specific feature of the French FAP market is the significant consumption of shellfish (mussels, oysters, etc.), which is linked to a significant domestic production.

The total value of household expenditure on FAPs was 8,012 million euros in 2020 (FranceAgriMer, 2021). Fresh products accounted for 32% of this total, chilled delicatessen products for 36%, frozen products for 16% and canned products for 15%. If we look at the global trends in the consumption of these preservation methods since 2011 (in terms of volume), we see that the consumption of fresh and frozen FAPs is tending to slow down. On the contrary, the consumption of chilled delicatessen products is growing, driven by a global trend towards eating more processed food in developed countries. The consumption of canned FAPs remains fairly stable (FranceAgriMer, 2023b). Supermarkets are, by far, the preferred place for French consumers to buy FAPs, with over 60% of purchases made through this channel (all conservation modes combined). Fishmongers, although very well developed in the region, account for a marginal proportion of purchases.

[9] The term species is somewhat overused here. We are not talking about species in the sense of environmental science, but rather species in the sense of consumption, which is often a set of species from environmental science.

## 0.8 - The data mobilised in this project

The data used in this thesis represent a significant contribution to the field, as they have enabled the acquisition of new insights regarding consumers' behaviour. Indeed, public data linked to the consumption of FAPs available on the French FAP market (mainly provided by FranceAgriMer) are mainly aggregated data linked to consumers' purchasing habits. This data includes information on the main species consumed, their market prices, their main distribution channels and their main modes of presentation. However, this aggregation limits the potential interest regarding the diversity of profiles and consumption behaviours. Moreover, these data do not address the question of labels, which is at the centre of this thesis, and available data on this topic are quite limited. Although some certifiers may possess some data on the subject, the information available is often limited for strategic reasons or else is available in aggregated form.

In order to complement the existing data and acquire new knowledge on labels and individual behaviour, two consumption surveys were performed during the thesis, in 2021 and 2023[10]. These surveys were performed online and contained declarative data. These two surveys aimed to measure French consumers' preferences regarding FAPs in general and labelled FAPs in particular. The samples used are also interesting, with an initial sample of 1,504 respondents and a second sample of 2,000 respondents (before processing the responses). The second survey included an oversampling of younger generations. With the exception of this oversampling, these two samples are representative of the French population in terms of gender and age. To do so, the quota method was performed.

We chose to work on declarative data, notably to test certain of our research hypotheses and to question consumer preferences regarding alternatives that are not currently available on the market. However, we know that this type of data has well-known limits. Indeed, as self-reported data, there is a risk of a gap between declarative consumption behaviour and real consumption behaviour (Carlucci *et al.*, 2015). This gap is even more pronounced when it comes to sustainable consumption behaviour, notably because consumers tend to overestimate their green behaviour due to social desirability (Young *et al.*, 2010). Despite these limitations, this type of data is still widely used in the existing literature, particularly to study consumer behaviour.

It is important to note that in this PhD thesis, the analysis only focused on hypothetical voluntary schemes. This is a deliberate choice on the part of my co-authors and myself, which is justified with regard to recent consumer studies focusing on labels on the French market (our reference market). Indeed, a survey conducted by FranceAgriMer in 2019 (FranceAgriMer, 2019) revealed a high level of "label brand" recognition within this market. To limit this bias, we therefore decided to work on hypothetical schemes. Through this approach, we wanted to test consumer preferences for a specific FAP attribute, and not a specific brand. As trust and credibility are important predictors of label acceptance by consumers (Siriex *et al.*, 2013), we described them as such to consumers in all of our surveys.

[10] Funded by (1) COPECO - COVID RCN and (2) FORESEA 2050 research programmes.

## 0.9 - References

**Akerlof, G. A.** (1970). The market for "Lemons": Quality uncertainty and the market. *The Qualerty Journal of Economics*, *84*, 488–500. https://doi.org/10.1016/b978-0-12-214850-7.50022-x

**Alfnes, F., Chen, X., & Rickertsen, K.** (2018). Labeling farmed seafood: A review. *Aquaculture Economics and Management*, *22*(1), 1–26. https://doi.org/10.1080/13657305.2017.1356398

**Almeida, C., Altintzoglou, T., & Cabral, H.** (2015). Does seafood knowledge relate to more sustainable consumption ? *British Food Journal*, *117*(2), 894–914. https://doi.org/10.1108/BFJ-04-2014-0156

**Apostolidis, C., & McLeay, F.** (2019). To meat or not to meat? Comparing empowered meat consumers' and anti-consumers' preferences for sustainability labels. *Food Quality and Preference*, *77*, 109–122. https://doi.org/https://doi.org/10.1016/j.foodqual.2019.04.008

**Asche, F., Larsen, T. A., Smith, M. D., Sogn-Grundvåg, G., & Young, J. A.** (2015). Pricing of eco-labels with retailer heterogeneity. *Food Policy*, *53*, 82–93. https://doi.org/https://doi.org/10.1016/j.foodpol.2015.04.004

**Asioli, D., Aschemann-Witzel, J., & Nayga, R. M.** (2020). Sustainability-Related Food Labels. *Annual Review of Resource Economics*, *12*(1), 171–185. https://doi.org/10.1146/annurev-resource-100518-094103

**Banovic, M., Reinders, M. J., Claret, A., Guerrero, L., & Krystallis, A.** (2019). A cross-cultural perspective on impact of health and nutrition claims, country-of-origin and eco-label on consumer choice of new aquaculture products. *Food Research International*, *123*(January), 36–47. https://doi.org/10.1016/j.foodres.2019.04.031

**Béné, C., Oosterveer, P., Lamotte, L., Brouwer, I. D., de Haan, S., Prager, S. D., Talsma, E. F., & Khoury, C. K**. (2019). When food systems meet sustainability – Current narratives and implications for actions. *World Development*, *113*, 116–130. https://doi.org/10.1016/j.worlddev.2018.08.011

**Birch, D., & Lawley, M.** (2012). Buying seafood: Understanding barriers to purchase across consumption segments. *Food Quality and Preference*, *26*(1), 12–21. https://doi.org/https://doi.org/10.1016/j.foodqual.2012.03.004

**Bjorndal, T., Lappo, A., Fernandez-polanco, J. M., & Lem, A.** (2014). Consumer trends and preferences in the demand for food. In SNF Working Paper: Vol. 51(13). https://www.ntnu.no/documents/1265701259/0/Consumer+trends+and+preferences+in+the+demand+for+food.pdf/7a4f661c-6ef1-4171-8b62-aa0b69a9ac5a

**Bouchery, Y., J. Corbett, C., Jan C, F., & Tan, T.** (2016). *Sustainable Supply Chains* (Springer (ed.); Second). Springer Cham.

**Brécard, D., Hlaimi, B., Lucas, S., Perraudeau, Y., & Salladarré, F.** (2009). Determinants of demand for green products: An application to eco-label demand for fish in Europe. *Ecological Economics*, *69*(1), 115–125.

https://doi.org/10.1016/j.ecolecon.2009.07.017

**Brécard, D., Lucas, S., Pichot, N., & Salladarré, F.** (2012). Consumer preferences for eco, health and fair trade labels. An application to seafood products in France. *Journal of Agricultural and Food Industrial Organization*, *10*(1). https://doi.org/https://doi.org/10.1515/1542-0485.1360

**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/https://doi.org/10.1016/j.ecolecon.2017.06.005

**Brunsø, K., Hansen, K. B., Scholderer, J., Honkanen, P., Olsen, S. O., & Verbeke, W.** (2008). Consumer attitudes and seafood consumption in Europe. *Improving Seafood Products for the Consumer*, 16–39. https://doi.org/10.1533/9781845694586.1.16

**Carlucci, D., Nocella, G., De Devitiis, B., Viscecchia, 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/https://doi.org/10.1016/j.appet.2014.10.008

**Caswell, J. A., & Padberg, D. I.** (1992). Toward a More Comprehensive Theory of Food Labels. *American Journal of Agricultural Economics*, *74*(2), 460–468. https://doi.org/10.2307/1242500

**Caswell, J. A., & Mojduszka, E. M.** (1996). Using Informational Labeling to Influence the Market for Quality in Food Products. *American Journal of Agricultural Economics*, *78*(5), 1248–1253. https://doi.org/10.2307/1243501

**Chen, X., Alfnes, F., & Rickertsen, K.** (2015). Consumer preferences, ecolabels, and effects of negative environmental information. *AgBioForum*, *18*(3), 327–336. https://hdl.handle.net/10355/48148

**Chikudza, L., Gauzente, C., Guillotreau, P., & Alexander, K. A.** (2020). Producers perceptions of the incentives and challenges of adopting ecolabels in the European finfish aquaculture industry: A Q-Methodology approach. *Marine Policy*. https://doi.org/https://doi.org/10.1016/j.marpol.2020.104176c

**Claret, A., Guerrero, L., Aguirre, E., Rincón, L., Hernández, M. D., Martínez, I., Benito Peleteiro, J., Grau, A., & Rodríguez-Rodríguez, C.** (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

**Claret, A., Guerrero, L., Ginés, R., Grau, A., Hernández, M. D., Aguirre, E., Peleteiro, J. B., Fernández-Pato, C., & Rodríguez-Rodríguez, C.** (2014). Consumer beliefs regarding farmed versus wild fish. *Appetite*, *79*, 25–31. https://doi.org/10.1016/j.appet.2014.03.031

**Clark, B., Stewart, G. B., Panzone, L. A., Kyriazakis, I., & Frewer, L. J.** (2017). Citizens, consumers and farm animal welfare: A meta-analysis of willingness-to-pay studies. *Food Policy*, *68*, 112–127. https://doi.org/10.1016/j.foodpol.2017.01.006

**Crevoisier, O., & Jeannerat, H.** (2009). Les dynamiques territoriales de connaissance : relations multilocales et ancrage regional. *Revue d'économie industrielle*, *128*(4), 77–99. https://doi.org/10.4000/rei.4072

**Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F. N., & Leip, A.** (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*, *2*(3), 198–209. https://doi.org/10.1038/s43016-021-00225-9

**Crona, B. I., Daw, T. M., Swartz, W., Norström, A. V, Nyström, M., Thyresson, M., Folke, C., Hentati-Sundberg, J., Österblom, H., Deutsch, L., & Troell, M.** (2016). Masked, diluted and drowned out: how global seafood trade weakens signals from marine ecosystems. *Fish and Fisheries*, *17*(4), 1175–1182. https://doi.org/https://doi.org/10.1111/faf.12109

**Crona, B. I., Wassénius, E., Jonell, M., Koehn, J. Z., Short, R., Tigchelaar, M., Daw, T. M., Golden, C. D., Gephart, J. A., Allison, E. H., Bush, S. R., Cao, L., Cheung, W. W. L., DeClerck, F., Fanzo, J., Gelcich, S., Kishore, A., Halpern, B. S., Hicks, C. C., … Wabnitz, C. C. C.** (2023). Four ways blue foods can help achieve food system ambitions across nations. *Nature*, *616*(7955), 104–112. https://doi.org/https://doi.org/10.1038/s41586-023-05737-x

**Cubero Dudinskaya, E., Naspetti, S., Arsenos, G., Caramelle-Holtz, E., Latvala, T., Martin-Collado, D., Orsini, S., Ozturk, E., & Zanoli, R.** (2021). European Consumers' Willingness to Pay for Red Meat Labelling Attributes. *Animals : An Open Access Journal from MDPI*, *11*(2). https://doi.org/10.3390/ani11020556

**Darby, M. R., & Karni, E.** (1973). Free Competition and the Optimal Amount of Fraud. *The Journal of Law and Economics*, *16*(1), 67–88. https://doi.org/https://doi.org/10.1086/466756

**de Boer, J., Hoogland, C. T., & Boersema, J. J.** (2007). Towards more sustainable food choices: Value priorities and motivational orientations. *Food Quality and Preference*, *18*(7), 985–996. https://doi.org/https://doi.org/10.1016/j.foodqual.2007.04.002

**Dufeu, I., Ferrandi, J.-M., Gabriel, P., & Le Gall-Ely, M.** (2014). Socio-environmental multi-labelling and consumer willingness to pay. *Recherche et Applications En Marketing*, *29*(3), 35–56. https://doi.org/https://doi.org/10.1177/2051570714542063

**EU Food Policy Coalition.** (2021). *Discovering the role of Food Environments for sustainable food systems* (Issue October). https://foodpolicycoalition.eu/wp-content/uploads/2021/10/Food-Environments-for-SFS_EU-FPC.pdf

**EUMOFA.** (2022). *The EU fish market – 2022 edition*. https://doi.org/10.2771/716731

**FAO.** (2022). *The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation*. https://doi.org/https://doi.org/10.4060/cc0461en

**FAO.** (2023a). *The State of Food Security and Nutrition in the World - 2023 - Urbanization, Agrifood sytems, Tranformation ann Healthy diets across the rural - urban continuum.*

https://www.fao.org/3/cc3017en/cc3017en.pdf

**FAO.** (2023b). *The State of Food and Agriculture: Revealing the True Cost*. https://www.fao.org/3/cc7724en/cc7724en.pdf

**Feldmann, C., & Hamm, U.** (2015). Consumers' perceptions and preferences for local food: A review. *Food Quality and Preference*, *40*(PA), 152–164. https://doi.org/10.1016/j.foodqual.2014.09.014

**Fonner, R., & Sylvia, G.** (2015). Willingness to Pay for Multiple Seafood Labels in a Niche Market. *Marine Resource Economics*, *30*(1), 51–70. https://doi.org/10.1086/679466

**FranceAgrimer.** (2019). *Aquatic products image barometer - Study report - December 2019*. https://www.franceagrimer.fr/fam/content/download/63160/document/Synthèse FranceAgrimer - V2 2019.pdf?version=2

**FranceAgriMer.** (2021). The fisheries and aquaculture sector in France (2021). In *FranceAgriMer*. https://www.franceagrimer.fr/fam/content/download/67037/document/STA_MER_chiffres_cles.pdf?version=3

**FranceAgriMer.** (2022a). *L'impact de l'inflation sur la consommation alimentaire en 2022*. https://www.franceagrimer.fr/Actualite/L-impact-de-l-inflation-sur-la-consommation-alimentaire-en-2022

**FranceAgriMer.** (2022b). *The fisheries and aquaculture sector in France (2022)*. https://www.franceagrimer.fr/content/download/69398/document/20230216_CC%20p%C3%AAche%20aqua%20ANG.pdf

**FranceAgriMer.** (2023a). *The fisheries and aquaculture sector in France (2023)*. https://www.franceagrimer.fr/fam/content/download/67049/document/STA_MER_chiffres_cles_english.pdf?version=2

**FranceAgriMer.** (2023b). Consommation des produits de la pêche et de l'aquaculture 2022. In *Données et bilans de l'Etablissement national des produits de l'agriculture et de la mer*. https://www.franceagrimer.fr/content/download/72643/document/STA_MER_CONSO_2022.pdf

**Gephart, J. A., Henriksson, P. J. G., Parker, R. W. R., Shepon, A., Gorospe, K. D., Bergman, K., Eshel, G., Golden, C. D., Halpern, B. S., Hornborg, S., Jonell, M., Metian, M., Mifflin, K., Newton, R., Tyedmers, P., Zhang, W., Ziegler, F., & Troell, M.** (2021). Environmental performance of blue foods. *Nature*, *597*(7876), 360–365. https://doi.org/10.1038/s41586-021-03889-2

**Golden, C. D., Koehn, J. Z., Shepon, A., Passarelli, S., Free, C. M., Viana, D. F., Matthey, H., Eurich, J. G., Gephart, J. A., Fluet-Chouinard, E., Nyboer, E. A., Lynch, A. J., Kjellevold, M., Bromage, S., Charlebois, P., Barange, M., Vannuccini, S., Cao, L., Kleisner, K. M., … Thilsted, S. H.** (2021). Aquatic foods to nourish nations. *Nature*, *598*(7880), 315–320. https://doi.org/10.1038/s41586-021-03917-1

**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. https://doi.org/10.1017/S0007114520003773

**Gracia, A., & de-Magistris, T.** (2016). Consumer preferences for food labeling: What ranks first? *Food Control*, *61*, 39–46. https://doi.org/10.1016/j.foodcont.2015.09.023

**Grunert, K. G.** (2011). Sustainability in the Food Sector: A Consumer Behaviour Perspective. *International Journal on Food System Dynamics*, *2*(3), 207–218. https://doi.org/10.18461/ijfsd.v2i3.232

**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

**Hallström, E., Bergman, K., Mifflin, K., Parker, R., Tyedmers, P., Troell, M., & Ziegler, F.** (2019). Combined climate and nutritional performance of seafoods. *Journal of Cleaner Production*, *230*, 402–411. https://doi.org/10.1016/j.jclepro.2019.04.229

**Hilborn, R., Banobi, J., Hall, S. J., Pucylowski, T., & Walsworth, T. E.** (2018). The environmental cost of animal source foods. *Frontiers in Ecology and the Environment*, *16*(6), 329–335. https://doi.org/10.1002/fee.1822

**HLPE.** (2017). *HLPE Report # 12 - Nutrition and food systems*. *September*, 152. https://www.unscn.org/en/news-events/recent-news?idnews=1745

**Irz, X., Leroy, P., Réquillart, V., & Soler, L. G.** (2018). Fish in climate-friendly and healthy diets. *Marine Resource Economics*, *33*(4), 319–330. https://doi.org/10.1086/699882

**Jacobs, S., Sioen, I., Pieniak, Z., De Henauw, S., Maulvault, A. L., Reuver, M., Fait, G., Cano-Sancho, G., & Verbeke, W.** (2015). Consumers' health risk-benefit perception of seafood and attitude toward the marine environment: Insights from five European countries. *Environmental Research*, *143*(B), 11–19. https://doi.org/https://doi.org/10.1016/j.envres.2015.02.029

**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

**Janßen, D., & Langen, N.** (2017). The bunch of sustainability labels – Do consumers differentiate? *Journal of Cleaner Production*, *143*, 1233–1245. https://doi.org/10.1016/j.jclepro.2016.11.171

**Jeannerat, H., & Kebir, L.** (2016). Knowledge, Resources and Markets: What Economic System of Valuation? *Regional Studies*, *50*(2), 274–288. https://doi.org/10.1080/00343404.2014.986718

**Johnston, R. J., Wessells, C. R., & Asche, F.** (2001). Measuring Consumer Preferences for Ecolabeled Seafood : An International Comparison. *Research in Economics*, *26*(42), 20–39. http://www.scopus.com/inward/record.url?eid=2-s2.0-0035593038&partnerID=tZOtx3y1

**Koehn, J. Z., Allison, E. H., Golden, C. D., & Hilborn, R.** (2022). The role of seafood in sustainable diets.

*Environmental Research Letters*, *17*(3). https://doi.org/10.1088/1748-9326/ac3954

**Kwasny, T., Dobernig, K., & Riefler, P.** (2022). Towards reduced meat consumption: A systematic literature review of intervention effectiveness, 2001–2019. *Appetite*, *168*, 105739. https://doi.org/https://doi.org/10.1016/j.appet.2021.105739

**Lancaster, K. J.** (1966). A New Approach to Consumer Theory. *Journal of Political Economy*, *74*(2), 106–107. https://doi.org/10.1007/978-3-642-51565-1_34

**Le Floc'h, P., & Wilson, J.** (2017). *Les pêches maritimes françaises* (P. universitaires de Rennes (ed.); Economie,). https://doi.org/10.4000/books.pur.63630

**López-Mas, L., Claret, A., Reinders, M. J., Banovic, M., Krystallis, A., & Guerrero, L.** (2021). Farmed or wild fish? Segmenting European consumers based on their beliefs. *Aquaculture*, *532*(June 2020), 735992. https://doi.org/10.1016/j.aquaculture.2020.735992

**Lucas, S., Soler, L.-G., & Revoredo-Giha, C.** (2021). Trend analysis of sustainability claims: The European fisheries and aquaculture markets case. *Food Policy*, *104*(July), 102141. https://doi.org/https://doi.org/10.1016/j.foodpol.2021.102141

**Macdiarmid, J. I., Kyle, J., Horgan, G. W., Loe, J., Fyfe, C., Johnstone, A., & McNeill, G.** (2012). Sustainable diets for the future: Can we contribute to reducing greenhouse gas emissions by eating a healthy diet? *American Journal of Clinical Nutrition*, *96*(3), 632–639. https://doi.org/10.3945/ajcn.112.038729

**Maesano, G., Carra, G., & Vindigni, G.** (2019). Sustainable dimensions of seafood consumer purchasing behaviour: A review. *Quality - Access to Success*, *20*(S2), 358–364. https://www.researchgate.net/publication/336892564_Maesano_G_Carra_G_Vindigni_G_2019_SUSTAINABLE_DIMENSIONS_OF_SEAFOOD_CONSUMER_PURCHASING_BEHAVIOUR_A_REVIEW

**Maesano, G., Di Vita, G., Chinnici, G., Pappalardo, G., & D'Amico, M.** (2020). The Role of Credence Attributes in Consumer Choices of Sustainable Fish Products: A Review. In *Sustainability* (Vol. 12, Issue 23). https://doi.org/10.3390/su122310008

**Martin, H., Martin, R., & Zukauskaite, E.** (2019). The multiple roles of demand in new regional industrial path development: A conceptual analysis. *Environment and Planning A: Economy and Space*, *51*(8), 1741–1757. https://doi.org/10.1177/0308518X19863438

**Mazzocchi, C., Orsi, L., & Sali, G.** (2021). Consumers' Attitudes for Sustainable Mountain Cheese. *Sustainability*, *13*(4). https://doi.org/10.3390/su13041743

**McCluskey, J. J., & Loureiro, M. L.** (2003). Consumer Preferences and Willingness to Pay for Food Labeling: A discussion of Empirical Studies. *Journal of Food Distribution Research*, *34*(3), 95–102. http://cedb.asce.org/cgi/WWWdisplay.cgi?9703093

**Menozzi, D., Nguyen, T. T., Sogari, G., Taskov, D., Lucas, S., Castro-Rial, J. L. S., & Mora, C.** (2020). Consumers' preferences and willingness to pay for fish products with health and environmental labels: Evidence from five european countries. *Nutrients*, *12*(9), 1–22. https://doi.org/https://doi.org/10.3390/nu12092650

**Menozzi, D., Wongprawmas, R., Sogari, G., Gai, F., Parisi, G., & Mora, C.** (2023). The role of objective and subjective knowledge on the attitude and intention of Italian consumers to purchase farmed and wild fish. *Agricultural and Food Economics*, *11*(1), 1–25. https://doi.org/10.1186/s40100-023-00288-1

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

**Olsen, S. O.** (2008). Antecedents of Seafood Consumption Behaviour. *Journal of Aquatic Food Product Technology*, *13*(3), 79–91. https://doi.org/10.1300/J030v13n03

**Ortega, D., Wang, H., Wu, L., & Olynk, N.** (2011). Modeling Heterogeneity in Consumer Preferences for Select Food Safety Attributes in China. Food Policy, 36(2), 318–324. https://doi.org/https://doi.org/10.1016/j.foodpol.2010.11.030

**Perignon, M., Vieux, F., Soler, L. G., Masset, G., & Darmon, N.** (2017). Improving diet sustainability through evolution of food choices: Review of epidemiological studies on the environmental impact of diets. *Nutrition Reviews*, *75*(1), 2–17. https://doi.org/10.1093/nutrit/nuw043

**Pieniak, Z., Verbeke, W., Scholderer, J., Brunsø, K., & Olsen, S. O.** (2007). European consumers' use of and trust in information sources about fish. *Food Quality and Preference*, *18*(8), 1050–1063. https://doi.org/https://doi.org/10.1016/j.foodqual.2007.05.001

**Pieniak, Z., Verbeke, W., Scholderer, J., Brunsø, K., & Olsen, S. O.** (2008). Impact of consumers' health beliefs, health involvement and risk perception on fish consumption: A study in five European countries. *British Food Journal*, *110*(9), 898–915. https://doi.org/https://doi.org/10.1108/00070700810900602

**Pieniak, Z., Verbeke, W., Olsen, S. O., Hansen, K. B., & Brunsø, K.** (2010). Health-related attitudes as a basis for segmenting European fish consumers. *Food Policy*, *35*(5), 448–455. https://doi.org/10.1016/j.foodpol.2010.05.002

**Pilis, W., Stec, K., Zych, M., & Pilis, A.** (2014). Health benefits and risk associated with adopting a vegetarian diet. *Roczniki Panstwowego Zakladu Higieny*, *65*(1), 9–14. https://pubmed.ncbi.nlm.nih.gov/24964573/

**Poore, J., & Nemecek, T.** (2018). Reducing food's environmental impacts through producers and consumers. *Science*, *360*(6392), 987–992. https://doi.org/10.1126/science.aaq0216

**Richter, I., Thøgersen, J., & Klöckner, C. A.** (2017). Sustainable Seafood Consumption in Action: Relevant Behaviours and their Predictors. *Sustainability*, *9*(12). https://doi.org/10.3390/su9122313

**Roe, B. E., Teisl, M. F., & Deans, C. R.** (2014). The Economics of Voluntary Versus Mandatory Labels. *Annual*

*Review of Resource Economics*, *6*(1), 407–427. https://doi.org/10.1146/annurev-resource-100913-012439

**Roheim, C. A., Asche, F., & Santos, J. I.** (2011). The elusive price premium for ecolabelled products: Evidence from seafood in the UK market. *Journal of Agricultural Economics*, *62*(3), 655–668. https://doi.org/10.1111/j.1477-9552.2011.00299.x

**Rust, N. A., Ridding, L., Ward, C., Clark, B., Kehoe, L., Dora, M., Whittingham, M. J., McGowan, P., Chaudhary, A., Reynolds, C. J., Trivedy, C., & West, N.** (2020). How to transition to reduced-meat diets that benefit people and the planet. *The Science of the Total Environment*, *718*, 137208. https://doi.org/10.1016/j.scitotenv.2020.137208

**Salaün, Y., & Flores, K. (2001).** Information quality: Meeting the needs of the consumer. *International Journal of Information Management*, *21*(1), 21–37. https://doi.org/10.1016/S0268-4012(00)00048-7

**Salladarré, F., Guillotreau, P., Perraudeau, Y., & Monfort, M. C.** (2010). The demand for seafood eco-labels in France. *Journal of Agricultural and Food Industrial Organization*, *8*(1). https://doi.org/10.2202/1542-0485.1308

**Santeramo, F. G., Carlucci, D., De Devitiis, B., Seccia, A., Stasi, A., Viscecchia, R., & Nardone, G.** (2018). Emerging trends in European food, diets and food industry. *Food Research International*, *104*(November), 39–47. https://doi.org/10.1016/j.foodres.2017.10.039

**Sirieix, L., Delanchy, M., Remaud, H., Zepeda, L., & Gurviez, P.** (2013). Consumers' perceptions of individual and combined sustainable food labels: A UK pilot investigation. *International Journal of Consumer Studies*, *37*(2), 143–151. https://doi.org/https://doi.org/10.1111/j.1470-6431.2012.01109.x

**Sogn-Grundvåg, G., Larsen, T. A., & Young, J. A.** (2014). Product Differentiation with Credence Attributes and Private Labels: The Case of Whitefish in UK Supermarkets. *Journal of Agricultural Economics*, *65*(2), 368–382. https://doi.org/https://doi.org/10.1111/1477-9552.12047

**Sonntag, W. I., Lemken, D., Spiller, A., & Schulze, M.** (2023). Welcome to the (label) jungle? Analyzing how consumers deal with intra-sustainability label trade-offs on food. *Food Quality and Preference*, *104*(October 2022). https://doi.org/10.1016/j.foodqual.2022.104746

**Springmann, M.** (2020). Valuation of the health and climate-change benefits of healthy diets. In *FAO Agricultural Development Economics Working Paper 20-03* (Issue October). https://doi.org/10.4060/cb1699en

**Teixeira, C. M., & Silva, P. M.** (2024). The huge dilemma: how to increase seafood consumption for health benefits without impacting fisheries' sustainability? *International Journal of Food Science and Technology*, *59*(2), 661–672. https://doi.org/10.1111/ijfs.16841

**Tigchelaar, M., Leape, J., Micheli, F., Allison, E. H., Basurto, X., Bennett, A., Bush, S. R., Cao, L., Cheung, W. W. L., Crona, B., DeClerck, F., Fanzo, J., Gelcich, S., Gephart, J. A., Golden, C. D., Halpern, B. S., Hicks, C. C., Jonell, M., Kishore, A., … Wabnitz, C. C. C.** (2022). The vital roles of blue foods in the global

food system. *Global Food Security*, *33*, 100637. https://doi.org/https://doi.org/10.1016/j.gfs.2022.100637

**Uchida, H., Onozaka, Y., Morita, T., & Managi, S.** (2014). Demand for ecolabeled seafood in the Japanese market: A conjoint analysis of the impact of information and interaction with other labels. *Food Policy*, *44*, 68–76. https://doi.org/10.1016/j.foodpol.2013.10.002

**UNEP.** (2016). *Food Systems and Natura Resourcesl*. A Report of the Working Group on Food Systems of the International Resource Panel. Westhoek, H, Ingram J., Van Berkum, S., Özay, L., and Hajer M.. https://www.resourcepanel.org/reports/food-systems-and-natural-resources

**Vanhonacker, F., & Verbeke, W.** (2014). Public and Consumer Policies for Higher Welfare Food Products: Challenges and Opportunities. *Journal of Agricultural and Environmental Ethics*, *27*(1), 153–171. https://doi.org/10.1007/s10806-013-9479-2

**Verbeke, W.** (2005). Agriculture and the food industry in the information age. *European Review of Agricultural Economics*, *32*(3), 347–368. https://doi.org/10.1093/eurrag/jbi017

**Verbeke, W., & Ward, R. W.** (2006). Consumer interest in information cues denoting quality, traceability and origin: An application of ordered probit models to beef labels. *Food Quality and Preference*, *17*(6), 453–467. https://doi.org/10.1016/j.foodqual.2005.05.010

**Vieux, F., Perignon, M., Gazan, R., & Darmon, N.** (2018). Dietary changes needed to improve diet sustainability: Are they similar across Europe? *European Journal of Clinical Nutrition*, *72*(7), 951–960. https://doi.org/10.1038/s41430-017-0080-z

**Waley, D., Harris, M., Goudling, I., & Correira, M.** (2021). Catching up: Fish Welfare in Wild Capture Fisheries. In *Eurogroup for Animals* (Issue January). https://www.eurogroupforanimals.org/library/catching-fish-welfare-wild-capture-fisheries

**Weinstein, N. D.** (1988). The precaution adoption process. *Health Psychology*, *7*(4), 355–386. https://doi.org/10.1037//0278-6133.7.4.355

**Weitzman, J., & Bailey, M.** (2018). Perceptions of aquaculture ecolabels: A multi-stakeholder approach in Nova Scotia, Canada. *Marine Policy*, *87*(October 2017), 12–22. https://doi.org/10.1016/j.marpol.2017.09.037

**Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., … Murray, C. J. L.** (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, *393*(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

**Winson, A., Choi, J. Y., Hunter, D., & Ramsundar, C.** (2021). Ecolabeled seafood and sustainable consumption in the Canadian context: issues and insights from a survey of seafood consumers. *Maritime Studies*, *0123456789*. https://doi.org/10.1007/s40152-021-00245-y

**Young, W., Hwang, K., McDonald, S., & J Oates, C.** (2010). Sustainable consumption: green consumer behaviour when purchasing products. *Sustainable Development*, *18*(March 2009), 20–31. http://dx.doi.org/10.1002/sd.394

**Zander, K., & Feucht, Y.** (2018). Consumers' Willingness to Pay for Sustainable Seafood Made in Europe. Journal of International Food and Agribusiness Marketing, 30(3), 251–275. https://doi.org/https://doi.org/10.1080/08974438.2017.1413611

**Zander, K., Risius, A., Feucht, Y., Janssen, M., & Hamm, U.** (2018). Sustainable Aquaculture Products: Implications of Consumer Awareness and of Consumer Preferences for Promising Market Communication in Germany. *Journal of Aquatic Food Product Technology*, *27*(1), 5–20. https://doi.org/10.1080/10498850.2017.1390028

**Zander, K., Daurès, F., Feucht, Y., Malvarosa, L., Pirrone, C., & le Gallic, B.** (2022). Consumer perspectives on coastal fisheries and product labelling in France and Italy. *Fisheries Research*, *246*(November 2021). https://doi.org/10.1016/j.fishres.2021.106168

**Ziegler, F., Eigaard, O. R., Parker, R. W. R., Tyedmers, P. H., Hognes, E. S., & Jafarzadeh, S.** (2019). Adding perspectives to: "Global trends in carbon dioxide (CO2) emissions from fuel combustion in marine fisheries from 1950 - 2016". *Marine Policy*, *107*(December 2018), 103488. https://doi.org/10.1016/j.marpol.2019.03.001

# Chapter 1: The role of fishery and aquaculture products (FAPs) in ensuring sutainable and healthy diet in France

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**Abstract**

Although the consumption of Fishery and Aquaculture Products (FAPs) is promoted for its health benefits and its potential relevance in food system transition, it is essential that this consumption is managed carefully so as not to jeopardize the sustainability of the resource and ecosystems exploited. Consumers' choices are essential to lead the sector towards greater sustainability. Using three different data sources (i.e. a literature review, a consumption survey carried out on the French market in 2023, and public market data), the aim of this article is to understand current consumption characteristics in France including FAP consumers' behaviour, preferences and profiles in order to identify potential levers for aligning FAP consumption patterns with public health and resource conservation objectives. Using a ordered probit model and T-student tests, our results show that French FAP consumption is high but concentrated on a few species (mainly imported ones with sustainability issues) and on few people (the elderly, connoisseurs, and high-income consumers). In addition, price and difficulty of cooking are important barriers to FAP consumption frequency. In accordance with our results, levers for guiding French FAP consumers towards more sustainable behaviour and to align national FAP consumption with health recommendations are suggested. They include the incorporation of FAPs into existing food policies, the promotion of diversity in consumption through well-managed "under-utilised" species, the management of price barriers, and the importance of informing and educating young consumers.

**Keywords:** Food systems, Fishery and Aquaculture Products; sustainable and healthy diet; consumer behaviour; consumption patterns

**JEL Code:** Q22, D12

## 1.1 - Introduction

In recent decades, the sustainability of our food systems has come under intense scrutiny. Indeed, food systems contribute to 34% of global greenhouse gas (GHG) emissions worldwide (Crippa *et al.*, 2021) and are also directly linked to land use, water use, biodiversity loss, etc. (IPBES, 2019). Moreover, their ability to provide quality food for the world's growing population is also being questioned (FAO *et al.*, 2022). Although malnutrition is a global issue, current food consumption patterns in developed countries are linked to the rise of diseases such as obesity, diabetes and cardiovascular disease (FAO *et al.*, 2022). Meat production and consumption occupy a special place in the ongoing debate, being heavily criticized for their impact on the environment and public health, leading to a "lose-lose" diet. This vision is particularly acute in developed countries, where meat consumption is widespread. According to the latest EU report (European Commission, 2021a), Europeans consume about 69 kg of meat per year. Despite a recent downward trend in consumption, there is an urgent need to reduce it more drastically. According to the Lancet report (Willett *et al.*, 2019) "*Transformation to healthy diets by 2050 will require substantial dietary shifts, including a greater than 50% reduction in global consumption of unhealthy foods, such as red meat and sugar [...]".*

To achieve a "win-win" scenario, public policies encourage, among other things, dietary changes (Irz *et al.*, 2018). As discussed by (Perignon *et al.*, 2017), the choice of substitute products is essential, as such products also have their own externalities (from the environmental and/or the health perspective). In line with this reasoning, vegetarian diets are generally presented as viable alternatives (Perignon *et al.*, 2017; Vieux *et al.*, 2018; Springmann, 2020) that have the least environmental impact relative to their nutritional content (Willett *et al.*, 2019). However, plant-based diets can meet resistance, notably in developed countries. Mixed diets offer an interesting alternative. In this particular case, FAPs can be a promising solution. Indeed, FAPs are an interesting protein substitute. They are considered nutrient-rich foods, containing essential nutrients such as omega-3 fatty acids, zinc, calcium, iodine, and vitamins (Carlucci *et al.*, 2015; Golden *et al.*, 2021; Koehn *et al.*, 2022). These nutrients are essential for metabolic function as well as for fighting diseases such as obesity and cardiovascular disease. Overall, FAPs are described as being "greener" than meat (Gephart *et al.*, 2021; Crona *et al.*, 2023)[11]. Despite the current limitations of our food systems, FAPs are given a marginal place in food policy (Koehn *et al.*, 2022). As stated by the Food Policy Coalition in 2020, "*seafood production is almost completely ignored in the Farm to Fork Strategy*". In the EU, their inclusion is often limited to weekly nutritional recommendations (at least one or two portions per week in most European countries[12], with different portion sizes).

Although the current average consumption of FAPs in the EU is already high (23.28 kg per capita in 2020) (EUMOFA, 2022), the dietary recommendations for FAPs mentioned above are poorly followed by consumers

[11] Nevertheless, this result should be nuanced. There is a wide variety of species and production methods with different impacts.

[12] To obtain more information: https://knowledge4policy.ec.europa.eu/health-promotion-knowledge_gateway/topic/food-based-dietary-guidelines-europe_en

(Pieniak *et al.*, 2010; Clonan *et al.*, 2012; Carlucci *et al.*, 2015). According to EUMOFA (2022), there are large disparities between Member States (58kg per capita on average in Portugal compared to 6 kg in the Czech Republic) but also between consumers, as 11% of EU consumers never eat FAPs according to the latest EUROBAROMETER (European Commission, 2021b). In addition, the three most consumed species in the EU are tuna, salmon, and cod[13]. These species may come from overexploited stocks (ICES) or unsustainable aquaculture production. It is thus necessary to rethink and promote the consumption of FAPs in high-consumption countries in order to meet public health objectives without jeopardizing the sustainability of marine resources and ecosystems. To achieve this objective, it is necessary to improve understanding of the characteristics and determinants of FAP consumption. This knowledge is essential to help formulate effective public policy recommendations (Birch *et al.*, 2012; Szolnoki and Hoffmann, 2014; Milford and Muiruri., 2024).

The French FAPs market will be used for a case study, as it is one of the leading FAP consumption markets in Europe (more than 30kg/year/capita) and due to the apparent diversity of FAPs consumed (ranging from fresh, frozen, delicatessen and canned products). Despite annual public information on FAP purchasing (FranceAgriMer, 2023a), available data (generally aggregated) do not provide clear understanding of the diversity of purchasing behaviour (species type, frequency, location, etc.) associated with different consumer profiles (socio-demographic characteristics, preferences, knowledge, etc.). Moreover, they do not allow an accurate assessment of the sustainability of FAP consumption or its compatibility with public health objectives issued by the French National Agency for Food, Environment and Health (ANSES). ANSES recommends that individuals should consume two portions of FAPs per week (i.e. 200g)[14].

Based on a literature review regarding the drivers of FAP consumption and the results from a consumption survey, this article aims to:

- provide better understanding of current FAP consumption patterns in France and their consistency with global public health and environmental objectives;
- identify the drivers and the consumer profiles behind the diverse consumption behaviours (based on the frequency of FAP consumption);
- propose recommendations for public policies to promote sustainable consumption of FAPs, which also responds to nutritional objectives.

The article is structured as follows. In section 2, we identify and discuss the main determinants of FAP consumption using the existing literature. In section 3, we present the data and the methodology used in this article. In Section 4, we present our results. In the last section, we provide several recommendations to

[13] To obtain more information: https://oceans-and-fisheries.ec.europa.eu/facts-and-figures/ facts-and-figures-common-fisheries-policy/consumption_en

[14] To obtain more information on these nutritional recommendations : https://www.mangerbouger.fr/l-essentiel/les-recommandations-sur-l-alimentation-l-activite-physique-et-la-sedentarite/aller-vers/aller-vers-les-poissons-gras-et-maigres-en-alternance

improve existing policies regarding FAP consumption.

## 1.2 - Determinants of FAP consumption in the existing literature

Several explanations can be put forward for why current consumption patterns of FAPs are unsustainable and current policies fall far short of their objectives. The heterogeneity of consumers in terms of consumption behaviour is one of them. In the next section, we draw on the existing literature to provide an overview of the determinants of household consumption of FAPs. Here, we focus on home consumption, as consumption in collective and commercial catering may respond to other realities. The results from the literature are compared with the latest EUROBAROMETER (European Commission, 2021b), which measures the attitudes of EU consumers towards FAPs.

### 1.2.1 - Influence of consumers' socio-characteristics

According to Olsen (2003), Brunsø *et al.* (2008), Murray *et al.* (2017), Thong and Solgaard (2017) Cantillo *et al.* (2021) and Govzman *et al.* (2021), **age** is an important predictor of FAP consumption. Globally, older consumers tend to consume FAPs more regularly. The latest EUROBAROMETER (European Commission, 2021b) confirms this trend. In fact, 80% of people over 55 say they eat fish at least once a month, compared to only 56% of consumers aged 15-24. The existing literature lacks consensus on the effect of **gender** on FAP consumption. According to Verbeke (2005) and Thong and Solgaard (2017), men consume fewer FAPs than women, who consume them for health motivations. Nevertheless, according to Govzman *et al.* (2021), there is no evidence of a consensus on such an effect. Within the EU, this gender effect is not apparent. The latest EUROBAROMETER (European Commission, 2021b) highlights that consumption frequencies are quite similar between women and men. For example, 33% of women and 33% of men say they eat fish at least once a week.

The literature often highlights a correlation between **income** and the consumption of FAPs (Verbeke *et al.*, 2005; Thong and Solgaard, 2017; Cantillo *et al.*, 2021). The higher the income, the higher the consumption. This result was confirmed in the last EUROBAROMETER (European Commission 2021b). For example, 25% of people who have difficulties paying their bills "most of the time" say they eat fish at least once a week, compared with 36% of people who have no difficulties. Along the same lines, the **level of education** (correlated with the income level) seems to be central to the behaviour observed (Jahns *et al.*, 2014; Cantillo *et al.*, 2021; Govzman *et al.*, 2021; Marinac Pupavac *et al.*, 2022). Those with a higher level of education tend to consume FAPs more regularly. In the EU, 25% of manual workers say they eat FAPs at least once a week, compared to 39% of managers (European Commission, 2021b).

**Living in a coastal area** also influences FAP consumption. Indeed, the availability of FAPs, perceived as a barrier to their consumption (Govzman *et al.*, 2021; Marinac Pupavac *et al.*, 2022; Menozzi *et al.*, 2023), is greater in coastal areas. Moreover, familiarity is also a determinant regarding FAP consumption (Birch and Lawley, 2012), and coastal consumers are more accustomed to eating these products due to cultural and consumption habits. Finally, **knowledge** is an important determinant of FAPs consumption (Olsen, 2008; Birch and Lawley, 2012). According to various works, knowledge is correlated with a positive attitude towards FAPs

(Menozzi *et al.*, 2023), with the intention to buy them (Pieniak *et al.*, 2010; Menozzi *et al.*, 2023) and with their consumption (Almeida *et al.*, 2015). Although consumers often have limited knowledge about FAPs (Menozzi *et al.*, 2023), knowledge can be considered higher in coastal departments due to geographical proximity (Dewals *et al.*, 2024).

Other factors may influence FAP consumption, notably **household structure**. For example, the presence of children in the household can lead to a higher consumption rate (Verbeke *et al.*, 2005; Olsen, 2008), as FAPs are often promoted as essential for children's development. However, it can also result in lower consumption, notably linked to health risk perception (Birch and Lawley, 2012). In the same vein, the size of the household can also be a barrier to FAP consumption (Thong and Solgaard, 2017), as FAPs are associated with expensive products.

### 1.2.2 - Preferences of consumers regarding FAP credence attributes

**Health** is an important cross-cultural driver of food choice (Brunsø *et al.*, 2008; Béné *et al.*, 2019) and a historical driver of consumer demand for FAPs (Verbeke *et al.*, 2005, 2007a; Pieniak *et al.*, 2010; Bimbo *et al.*, 2022). Consumers already associated FAPs with healthy products in the 2000s (Verbeke *et al.* 2005; Brunsø *et al.* 2009), and this perception persists today (Carlucci *et al.*, 2015). FAPs contribute to a balanced and nutritive diet and are perceived as healthier than meat (Brunsø *et al.*, 2009; Bimbo *et al.*, 2022; Crona *et al.*, 2023). According to Cantillo *et al.* (2021), this health attribute is one of the main reasons for consuming FAPs inside the EU. Although the presence of harmful contaminants in FAPs can be a barrier to their consumption (Birch and Lawley, 2012; Govzman *et al.*, 2021), according to the latest EUROBAROMETER (European Commission, 2021b), only 10% of consumers who never or almost never eat fish explain this by perceived "health concerns", underlying a still limited perception of these risks. Globally, the perceived benefits of FAP consumption continue to outweigh the perceived risks (Jacobs *et al.*, 2015).

Another determining attribute in FAPs consumption is the **country of origin** (Maesano *et al.*, 2020). There is, indeed, a strong preference for domestic over imported products (Brécard *et al.*, 2009; Claret *et al.*, 2012; Uchida *et al.*, 2014; Rickertsen *et al.*, 2017; Santeramo *et al.*, 2018; Banovic *et al.*, 2019; Marinac Pupavac *et al.*, 2022). Consumers perceive local products as fresher, safer and therefore of higher quality than imported ones. Feucht and Zander (2017) show, for example, that EU consumers associate local FAPs with being fresher than EU-origin FAPs. Behind this question of quality, consumers can also associate domestic production with economic support for their national sector, the generation of jobs, cultural heritage, better regulations, etc. (Feucht and Zander, 2017; Marinac Pupavac *et al.*, 2022). A recent focus group conducted on the French market[15] also highlights that consumers associate domestic production with more guarantees regarding the environmental or ethical aspects of products, especially compared with products imported from outside the EU.

Consumers are also increasingly concerned about the **environmental impact** of their FAPs (Brécard *et al.*, 2009; Salladarré *et al.*, 2010; Brécard *et al.*, 2012). Indeed, FAP production can impact the marine environment

[15] This study looks at consumer expectations regarding the labelling of aquatic products and is available at the following link: https://www.franceagrimer.fr/filiere-peche-et-aquaculture/Eclairer/Etudes-et-Analyses/ Etudes-et-syntheses

(overfishing, impact on the seabed, on protected species, eutrophication, etc.). This green interest seems to be still in the process of emerging compared to historical drivers such as health. Indeed, if we look at consumers' main interest when buying FAPs, the ethical aspect of their products is positioned far behind quality or origin considerations (European Commission, 2021b). FAP consumers tend to prioritize the self-oriented aspect of consumption over the more altruistic ones (Sonntag *et al.*, 2023). This partly explains why the species most consumed across the EU remain highly problematic seen from the environmental side.

Other FAP attributes can also influence consumers' FAP consumption. There is, for example, a growing trend towards **animal welfare** (Maesano *et al.*, 2020), mainly related to the aquaculture sector (Alfnes *et al.*, 2018; Zander and Feucht, 2018a). However, this issue is also gaining ground regarding wild production (Waley *et al.*, 2021). Social considerations, more related to working conditions, can also influence demand for FAPs, but this remains marginal compared to other attributes of interest, as presented in the last EUROBAROMETER (European Commission, 2021b).

FAPs consumption behaviour can also be influenced by **production method**. Indeed, consumers' perception of wild and farmed seafood is differentiated (Verbeke *et al.*, 2007a; Claret *et al.*, 2014; Cardoso *et al.*, 2013). According to Verbeke *et al.* (2007a), Rickertsen *et al.* (2017), Maesano *et al.* (2020) and Bimbo *et al.* (2022), wild fish are perceived as having a better taste, along with being healthier and more nutritious. Consumers express distrust regarding the safety of farmed seafood, based on certain beliefs (Claret *et al.*, 2014; Menozzi *et al.*, 2023). Regular FAP consumers tend to prefer wild products (European Commission, 2021b).

### 1.2.3 - Preferences of consumers regarding FAP characteristics

FAP **sensory qualities** are important drivers of current consumption behaviour (Zander *et al.*, 2018b). Globally, FAPs are perceived as tasty by consumers (Brunsø *et al.*, 2008, 2009; Murray *et al.*, 2017), and taste is a crucial driver of FAP consumption among regular consumers (Cantillo *et al.*, 2021). However, taste can also act as a barrier to FAP consumption. Indeed, according to the last EUROBAROMETER (European Commission, 2021b), 40% of people who never or almost never eat fish state this is because they dislike the taste, the smell or the appearance of these products. This "taste" barrier appears to be linked to familiarity with the products and is more present among young consumers (Brunsø *et al.*, 2008). **Product presentation** is an important factor in FAP consumption as it is often used as an indicator of quality by consumers. Indeed, this is the first important aspect for EU consumers when purchasing FAPs (European Commission, 2021b). Generally, fresh FAPs are perceived to be of higher quality than processed ones (Brunsø *et al.*, 2009). Cantillo *et al.* (2021) show that regular consumers prefer fresh products over processed ones. On the contrary, occasional consumers tend to prioritize frozen products, as fresh FAPs are perceived as more time-consuming to prepare (Brunsø *et al.*, 2009). This may explain why chilled delicatessen FAPs have been gaining a greater share of the market, notably in the French market (FranceAgriMer, 2023a).

Finally, **price** is often perceived as a barrier to FAP consumption (Brunsø *et al.*, 2009; Thong and Solgaard, 2017; Bimbo *et al.*, 2022; Marinac Pupavac *et al.*, 2022). Indeed, FAPs are often perceived as expensive.

According to the latest EUROBAROMETER (European Commission, 2021b), the cost of the products is the second most important aspect for EU consumers when they buy FAPs. This perception is lower among regular consumers, who have more financial resources. Thong and Solgaard (2017) even state that reducing production costs could be an interesting lever to increase the sector's share of the market.

## 1.3 - Materials and methods

### 1.3.1 - Data

1.3.1.1 - Survey data

Based on our literature review, an online consumption survey was carried out in 2023 in the French market. This survey was included in the framework of the FORESEA 2050 research program[16]. The purpose of this survey was to analyze French consumption habits and preferences regarding FAPs. To do so, the study was divided into 72 questions included in several distinct blocks: 1) FAPs consumption habits; 2) FAPs consumption behaviour for fresh products; 3) Consumers' preferences for FAPs; 4) Motivations, knowledge and implication of FAPs consumers; 5) The bidding process; and, lastly, 6) Consumers' characteristics. An initial sample of 2,000 consumers was collected, reduced to 1,895 after processing. The characteristics of this sample are presented in Table 1.1.

**Table 1.1 - Characteristics of the sample (n = 1,895)**

| | Sample | | France[1] | |
|---|---|---|---|---|
| **Gender (%)** | Male | Female | Male | Female |
| | 47.1 | 52.9 | 48.3 | 51.7 |
| **Socioprofessional Category (%)** | | | | |
| Farmers | 0.4 | | 0.8 | |
| Craftsmen, retailers and business owners | 4.0 | | 3.5 | |
| Managers and higher intellectual professions | 11.9 | | 9.5 | |
| Intermediate professions | 12.4 | | 14.1 | |
| Employees | 29.9 | | 16.1 | |
| Workers | 5.9 | | 12.1 | |
| Retirees | 21.6 | | 26.9 | |
| Other non-working people | 13.9 | | 17.0 | |
| **Age categories (%)** | | | | |
| [18-34] | 44.2 | | 22.6 | |
| [35-49] | 18.6 | | 24.9 | |
| [50-64] | 18.4 | | 25.2 | |
| [65+] | 18.8 | | 27.2 | |

Source - FORESEA 2050 database

[1]INSEE, data from 2021

*Note: Our sample includes an over-sampling of young people and employees (with regard to the objectives of the FORESEA-2050 research program). To adjust it, we, therefore, applied weighting coefficients to each of the results discussed below.*

Regarding our research objectives, we wanted to test the influence of consumer characteristics on their

[16] For information on this program: https://www.umr-amure.fr/projets-scientifiques/foresea-2050/

reported FAP consumption frequency. In our case, our dependent variable *y* is categorical, with 1 = consumers eat fish at least once a week; 2 = consumers eat fish at least once a month; 3 = Consumers eat fish less than once a month. With regard to our literature review, we are interested in the effect of consumers' age, gender, presence of children under 18 in the household, place of residence, income, objective knowledge of the sector, attention paid to price when buying FAPs, their preferences for FAPs and their perceptions of four specific attributes (health, taste, expensive, difficult to cook) on their consumption frequency.

The variable related to age is a continuous variable. Gender is a binomial variable, coded 1 if our consumer is a female; otherwise 0. The presence of children in the household is coded 1 if children under 18 are present in the household; otherwise 0. The place of residence variable measures whether or not the individual lives in a coastal department, based on the postcodes specified by our customers in our survey. This binary variable is coded 1 if the consumer lives in a coastal department, and 0 otherwise.

Our income variable is categorical. The first category includes individuals with a household income of less than €1,799, which is our reference category in the model. The second category includes individuals with a household income between €1,800 and €2,800, and the last category includes individuals with a household income higher than €2,800.

To test the relationship between knowledge and FAP consumption, we included a variable related to the objective knowledge of consumers. This variable is a score obtained from a series of 11 "Yes/No" questions. Each correct answer increases the score of this variable by 1. Table 1.A1 lists all the statements used and the correct answer. Prior to the survey, these statements were tested with experts and non-experts in the FAP sector in order to measure their ability to discriminate between the levels of knowledge of our consumers.

To test the influence of price on consumption frequency, we included a variable measuring the attention consumers pay to price when buying FAPs. We asked our consumers to position themselves on a scale from 0 (strongly disagree) to 10 (strongly agree) on the following question: "*Would you say that price is your first choice when buying fish AT HOME?"*

We also included seven different statements related to consumer preferences regarding FAPs. The first five statements relate to the intrinsic quality of FAPs. Consumers were asked to rate themselves on a scale from 0 (not at all important) to 10 (very important). Table 1.A2 presents these statements. The last two preferences relate to the production process. Consumers had to answer the following question: "*Whenever I can, I try to eat FAPs...*" For these two statements, consumers were asked to position themselves on a scale from - 3 (small-scale fishing; aquaculture products) to 3 (large-scale fishing; wild products).

We then included variables related to two main drivers of FAP consumption: FAP health perception and taste. To measure their importance, we asked our consumers to answer the following questions: "*In your opinion, regardless of how they are packaged, are fish good for your health*?" and "*In your opinion, regardless of how they are packaged, do fish have excellent taste qualities*?" We also wanted to test the effect of two barriers to FAP consumption: price and cooking difficulty. We, therefore, asked our consumers to answer the following

questions: "*In your opinion, regardless of how they are packaged, are fish expensive?*" and "*In your opinion, whatever form they come in, are fish difficult to cook?*". For these four questions, consumers were asked to rate their opinion on a scale from 1 (I strongly disagree) to 4 (I strongly agree).

1.3.1.2 - Public data

Furthermore, to obtain a current view of the overall structure of French consumption on the FAPs market, we used public data provided by FranceAgriMer[17]. In our case, we are interested in two particular reports. The first report is specifically dedicated to French FAPs consumption (FranceAgriMer, 2023a) and provides detailed purchase data regarding at-home consumption. It includes information on market trends (by preservation method, by species, by marketplace). It also proposes information on average market price and global household expenditure. The second report concerns key figures of the French FAPs market (FranceAgriMer, 2023b) particularly aggregate data on production (fish and aquaculture), firms, trade balance, and consumption.

### 1.3.2 - Methods

1.3.2.1 - Ordered probit model

Only survey data will be statistically processed. As we work here on a dependent variable that can be ordered, we implemented an ordered probit model to explain the behaviour observed. The ordered probit model is built around a latent regression (Greene, 2018). In our specific case, our dependent variable measures the frequency of FAP consumption.

If we note $i$ our individuals (with $i$ ranging from 1 to 1 895), and $k$ the choice modalities (with $k$ ranging from 1 to 3), the probability that an individual *i* chooses alternative k can be written as follows:

$$Prob(y_i = k) = F(x_i\beta) \quad (1)$$

$Prob(y_i = k)$ represents the probability that our individuals $i$ choose the $k$ alternative. $F$ is the distribution function, $X_i$ is the matrix of characteristics for individual $i$, and β is the vector of the model parameters.

As we use an ordered probit model, we can first state that:

$$y_{i=}\begin{cases} 1 \rightarrow At\ least\ once\ a\ week & if -\infty < y_i^* < \gamma_1 \\ 2 \rightarrow At\ least\ once\ a\ month & if\ \gamma_1 < y_i^* < \gamma_2 \\ 3 \rightarrow Less\ than\ once\ a\ month & if\ y_i^* > \gamma_3 \end{cases} \quad (2)$$

Here, $y_i$ represents our dependent variable, which can take the 1, 2 or 3 modality. $\gamma_m$ are constants delimiting the intervals of values of the latent variable $y_i^*$.

The general formula for the ordered probit model can be written as follows:

$$Prob(y_i = k) = F(\gamma_k - X_i\beta) - F(\gamma_{k-1} - X_i\beta) \quad (3)$$

The coefficients presented in this article will be the marginal effects. These coefficients are easier to

[17] FranceAgriMer is a French public institution which publishes data and reports on the French production sector, including FAPs. More information is available on the following link: https://www.franceagrimer.fr/

interpret. They represent a change in the probability of belonging to one of the three modalities of our dependent variable according to our different explanatory variables.

1.3.2.2 - Statistical tests of means comparison

We also wanted to test the difference in perception between wild and farmed products from the point of view of French consumers. To do so, we performed two distinct statistical tests. First, a variance comparison test (F-test), to compare the variance of the mean. If the hypothesis of equality of variances is accepted, then we can use a Student's t-test to compare our means (t-test). If this hypothesis is rejected, then, according to Overall *et al.* (1995), the Welch test provides more accurate results. In our case, we implemented only the Welch test. This test can be expressed as follows:

$$t - \text{Welch} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}} \quad (4)$$

With $X_n$ being the means to compare, $s_n$ the mean's standard deviation and $N_n$ the size of the two samples. This test measures if the differences between two means can be considered as statistically different. Here, the null hypothesis H0 states that the means are statistically equal. The alternative hypothesis Ha states that the mean is statistically different.

## 1.4 - Results

### 1.4.1 - General characteristics of FAP consumption in France

According to FranceAgriMer, the average consumption of FAPs is 31.8 kg per capita in 2021 (FranceAgriMer, 2023a). However, this consumption is driven by a small part of the population. Indeed, and based on the survey, only 40.84 % of consumers eat fish at least once a week at home, 34.78 % eat fish less than a month, and 24.38 % eat fish less than once a month. These results are in line with the latest EUROBAROMETER report (European Commission, 2021b) on home consumption.

Looking for other places of FAP consumption, we found that the consumption of FAPs in restaurants is occasional for most French consumers (less than 40% of our consumers declare they eat FAPs in restaurants once a month or more) and quite rare in canteens, where 54% of our sample declare they never eat FAPs in canteens.

If we combine the different places of consumption, Table 1.2 shows that only 46.07 % of consumers eat FAPs at least once a week. This means that (at least) 54% of consumers do not comply with the nutritional recommendation from French authorities of two portions per week. Indeed, 35.83% of consumers declare that they eat FAPs at least once a month, and 18.10 % declare that they eat FAPs less than once a month. Our study confirms that nutritional recommendations remain poorly followed in France.

**Table 1.2 - FAP consumption frequency**

| Frequency | Home | Restaurant | Canteen | Overall |
|---|---|---|---|---|
| Consumers eat FAPs at least once a week | 40.84 | 8.07 | 10.55 | 46.07 |
| Consumers eat FAPs at least once a month | 34.78 | 28.71 | 14.20 | 35.83 |
| Consumers eat FAPs less than once a month | 24.38 | 49.55 | 20.90 | 18.10 |
| Consumers never eat fish | X | 13.67 | 54.35 | X |

Source - FORESEA 2050 database

*Note: Consumers included in the survey were required to consume FAPs at home.*

In addition, current FAP consumption relies on a limited diversity of species. Indeed, tuna represents 15.5 % of the annual FAP consumption per capita, salmon 14.5%, cod 7.6 %, Alaska Pollack 7.2 % and mussel 6.9 %. These six species account for over half of the global French consumption (FranceAgriMer, 2023b). Some of these species are mainly raised (salmon, mussels), and others are mainly wild-captured (cod, tuna, Alaska pollack). If we look at their prices, species like salmon or cod are, on average, quite expensive: around €20 per kilo for fresh salmon or fresh cod (FranceAgriMer, 2023a). By way of comparison, the average price of meat in 2021 was €11.6 per kilo (FranceAgriMer, 2021). However, price depends on preservation methods. For example, fresh tuna is sold for an average of €23 per kilo, while canned tuna is less expensive (€9.9 per kilo) (FranceAgriMer, 2023a).

From the supply point of view, France's trade balance is heavily in deficit: minus €5.5 billion in 2021 (FranceAgriMer, 2023b). Indeed, although French fleets catch some of these species (tuna, cod, etc.), most of the species consumed are sourced from importations. Salmon represents, for example, the main imported species on the French market (FranceAgriMer, 2023b). Finally, if we look at preservation methods, French consumers tend to consume fewer fresh products over time and more delicatessen products (FranceAgriMer, 2023a). Canned and frozen FAP consumption remains stable. (FranceAgriMer, 2023a).

### 1.4.2 - Determinants of FAP consumption in France

Table 1.3 presents the results from our Ordered Probit Model. We see that getting older slightly increases the probability of being a heavy consumer (+0.003 probability point (pp)) and slightly decreases the probability of being an occasional consumer (-0.002 pp) and a medium consumer. (-0.001 pp). We also find an income effect. Belonging to the "middle income" class increases the probability of being a regular consumer by 8.7pp, and reduces the probability of belonging to the medium (-0.025 pp) and occasional (-0.062 pp) consumer categories. This effect is even more pronounced for the "high income" category, with a percentage of +0.125 pp for the heavy consumers, -0.032 pp for the medium consumers and -0.093 pp for the occasional consumers. Consumers with objective knowledge of the sector are also more likely to be in the heavy consumers category (+0.015 pp). In contrast, they are less likely to be medium consumers (-0.004 pp) and occasional consumers (-0.011 pp). Being a price-conscious consumer increases the probability of belonging to the occasional (+0.006 pp) and medium (+0.002 pp) consumer categories and reduces the probability of belonging to the heavy category (-0.008 pp). We do not find any gender effect, the department of residence and the presence of children in the household.

In terms of consumer preferences, we find a positive correlation between interest in the freshness of FAPs (+ 0.009 pp), preference for artisanal productions (+0.020 pp) and weekly consumption of FAPs. On the contrary, it reduces the probability of being a medium consumer (by -0.002 pp and -0.005 pp respectively) and of being an "occasional consumer" (by -0.007 pp and -0.015 pp respectively). The other preferences tested have no significant effect on reported consumption.

Regarding product attributes, we find a positive correlation between consumers who believe that fish is beneficial to health and heavy consumers (+0.049 pp) and a negative correlation with the medium consumers (- 0.012 pp) and occasional consumers (-0.038 pp) categories. The frequency of consumption is also influenced by the ease of cooking. Consumers who state that fish is easy to cook are more likely to be regular FAP consumers (+ 0.098 pp), and less likely to be medium (-0.023 pp) and occasional (-0.075 pp) consumers. Finally, consumers who perceive FAPs as expensive are not among the heavy consumers (-0.084 pp) and are most present in the medium (+0.020 pp) and occasional (+ 0.064 pp) consumer categories. The perception that FAPs are tasty does not influence the frequency of consumption.

**Table 1.3 - Ordered probit model results**

| | Occasional consumers (24.4 %) | | Medium consumers (34.8 %) | | Regular consumers (40.8 %) | |
|---|---|---|---|---|---|---|
| **Variables** | Coef | Std. Err | Coef | Std. Err | Coef | Std. Err |
| **Socio-demographics** | | | | | | |
| Age | -.002*** | .001 | -.001*** | .000 | .003*** | .001 |
| Male (ref) | | | | | | |
| Female | .005 | .017 | .002 | .005 | -.007 | .021 |
| Children | .001 | .018 | .000 | .005 | -.001 | .023 |
| Coastal dep. | -.005 | .017 | -.001 | .005 | .006 | .022 |
| Low.income (ref) | | | | | | |
| Mid.income | -.063*** | .022 | -.019*** | .007 | .082*** | .029 |
| High. income | -.091*** | .021 | -.028*** | .007 | .119*** | .027 |
| Knowledge | -.011*** | .003 | -.003*** | .001 | .014*** | .004 |
| Price attention | .006* | .003 | .002* | .001 | -.007* | .004 |
| **Consumers Preferences** | | | | | | |
| Fresh | -.007* | .004 | -.002* | .001 | .009* | .005 |
| Env.wild | -.007 | .005 | -.002 | .002 | .009 | .007 |
| Env.farmed | -.006 | .005 | -.002 | .002 | .007 | .007 |
| France | -.001 | .004 | -.000 | .002 | .002 | .006 |
| Health Hazards | -.003 | .004 | -.001 | .001 | .004 | .005 |
| Artisanal | -.015*** | .006 | -.005** | .002 | .020*** | .007 |
| Wild | -.002 | .006 | -.001 | .002 | .002 | .008 |
| **Products attributes** | | | | | | |
| Health | -.038* | .023 | -.012* | .007 | .049* | .029 |
| Tasty | -.035 | .026 | -.011 | .008 | .046 | .034 |
| Not difficult to cook | -.075*** | .023 | -.023*** | .007 | .098*** | .030 |
| Expensive | 0.064*** | .023 | .020*** | .007 | -.084*** | .031 |

Source - FORESEA 2050 database

*Note: Significance thresholds: *** 0.01; ** 0.05; * 0.1*

### 1.4.3 - A differentiated perception between wild and farmed products

Wild fisheries and aquaculture play an important and complementary role in achieving our healthy and sustainable food system transition. Nevertheless, consumers' perceptions regarding these two production methods are differentiated (Lopez-Mas *et al.*, 2021; Zander and Feucht, 2018a). Figure 1.1 presents our results regarding these contrasting perceptions according to our survey.

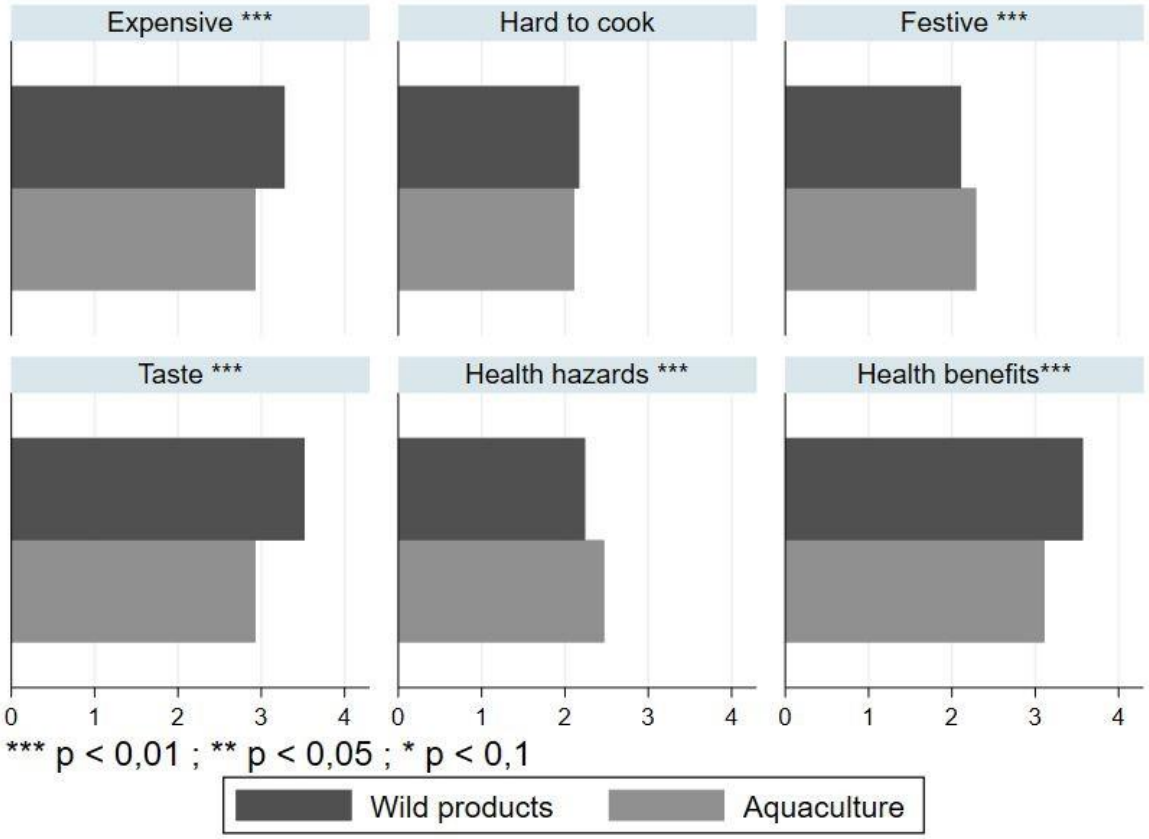


**Figure 1.1 - Perception differences between wild and aquaculture species (on a 1 to 4 scale)**
Source - FORESEA 2050 database

As expected, FAPs are perceived as expensive by consumers (mean = 3.10). However, French consumers perceive wild products as more expensive (3.28) than farmed ones (2.93). Consumers also associate FAPs with tasty products (3.22). Again, consumers consider wild species to be tastier (3.52) than aquaculture species (2.93). French consumers do not necessarily perceive FAPs as difficult to cook (2.14), with no differences seen between the two production methods. Globally, the perception that FAPs present certain health hazards is moderate (2.35). However, farmed FAPs are more associated with health risks (2.47) than wild species (2.25). In the same vein, although French consumers perceived FAPs as healthy (3.34), wild FAPs are more strongly associated with this attribute (3.57) than farmed ones (3.11).

## 1.5 - Discussion

The aim of this article is to reconsider the place of FAP consumption in the transition of our food systems. While FAPs offer undeniable opportunities to meet tomorrow's health and environmental dietary challenges, consumption patterns in developed countries such as France need to be adapted. Indeed, it is evident that actual consumption behaviours are not aligned with the desired objectives.

### 1.5.1 - Behavioural change is needed

1.5.1.1 - Make FAP consumption fair and more sustainable

Our findings indicate that at least 54% of French consumers do not follow French nutritional recommendations of consuming FAPs twice a week. Moreover, our model indicates that regular FAP consumers

are typically older with high incomes. Younger and low income consumers tend to consume fewer FAPs, confirming the results of the last EUROBAROMETER (European Commission, 2021b). Furthermore, some of the most consumed species can be considered problematic, especially from an environmental perspective. In order to achieve fairer FAP consumption, it is necessary to reconsider the consumption pattern of older consumers and encourage the younger generation to consume them. It is noteworthy that while older generations' consumption appears to be driven by health concerns (Olsen, 2003), younger generations are often perceived as being more influenced by environmental considerations (Ivanova *et al.*, 2019), including in the FAP sector (Brécard *et al.*, 2009; Salladarré *et al.*, 2010). Consequently, promoting resource-efficient and environmentally conscious consumption can be an effective strategy to appeal to this demographic while encouraging responsible behaviour.

1.5.1.2 - Integrate FAPs into public policy

The first step towards reaching our objectives of sustainable diet is to better integrate FAPs into future public food policies in developed countries, as defended by authors such as Béné *et al.* (2015), Bennett et al. (2021), Golden *et al.* (2021), Tigchelaar *et al.* (2022) and Crona *et al.* (2023). Indeed, although identified as essential, they are often marginally addressed in existing policies compared to other food commodities, such as meat or vegetables. Giving these products a more prominent position is crucial to reconciling public health objectives with sustainable consumption. Our discussion will, therefore, focus on various levers for integrating FAPs efficiently into food policy.

### 1.5.2 - Levers for successful integration of FAPs into public policy

1.5.2.1 - Expanding the range of species consumed

Currently, existing policies often discuss FAPs as a single commodity (Koehn *et al.*, 2022; Crona *et al.*, 2023), despite their vast diversity. The use of terms such as "blue food" or "seafood" in existing policies is therefore meaningless, as they group together highly diverse products. This aggregation also exists in the existing literature (Naylor *et al.*, 2021; Tigchelaar *et al.*, 2022). In their review regarding the role of credence attributes in consumer choice for sustainable FAPs, Maesano *et al.* (2020) state that "*A large number of studies analyzed […] considered fish and seafood as a unique and undifferentiated food category*". However, our results support the idea that FAPs are, on the contrary, a highly diversified group. Nevertheless, despite being an opportunity to achieve a transition toward more sustainable FAPs consumption, this diversity remains poorly exploited.

The diversification of consumption has been identified as a promising lever to achieve more sustainable consumption of FAPs (Koehn *et al.*, 2022; Teixeira and Silva, 2024). If high consumption species, such as imported salmon, are often associated with environmental and safety issues, promoting more "under-utilised" species would be a promising lever (Koehn *et al.*, 2020; Farmery *et al.*, 2020). Interestingly, while French consumption is concentrated on a few species, French fishers land more than 300 species, notably from Small-Scale Fisheries (SSF) (IFREMER, 2024). This species diversity offers undeniable potential to provide French consumers with potentially sustainable and healthy products, as each production's nutritional and environmental attributes are different (Golden *et al.*, 2021; Gephart *et al.*, 2021; Koehn *et al.*, 2022; Crona *et al.*, 2023). Small pelagic species such as sprat, sardine, mackerel or herring are often presented as green and nutritious species

(Hallström *et al.*, 2019, Gephart *et al.*, 2021, Koehn *et al.*, 2022). In our case, promoting new domestic production has the potential to open new markets for French producers, reduce the market's dependence on unsustainable imports, limit GHG associated with transport, reduce pressure on certain exploited stocks, etc. In addition, French domestic production, particularly the SSF, significantly lands fresh species. Promoting fresh FAP consumption could, therefore, help to reverse the current trend towards the consumption of delicatessen products. This is interesting from a public health point of view, as processed products are directly linked to health problems such as obesity (Ahern *et al.*, 2021). However, in order to effectively promote these new species, consumer acceptance and knowledge need to be increased through reliable messages (Farmery *et al.*, 2020; Koehn *et al.*, 2020).

Nevertheless, the diversification of consumption towards new species is not a panacea. In order to ensure the long-term viability of these potential new species, it is first essential to consider a number of factors, including stock sustainability, seasonality and availability. These considerations are of paramount importance when developing policies. Encouraging the consumption of new species can also be constrained by the difficulties involved in cooking them, which emerged as a significant barrier in our results. Consequently, it is necessary to educate consumers, for instance, by disseminating simple recipes. Moreover, as Heutte *et al.* (2023) demonstrated during the COVID crisis, the French consumer market is characterized by a high degree of inertia when it comes to the consumption of imported species, and changing consumption habits can be difficult. Long-term policies are thus required. Finally, promoting the consumption of new species also implies restructuring the existing market and supply chain, which must not compromise the economic viability of all the stakeholders, notably producers.

1.5.2.2 - Synergy of production methods

Diversity should also be taken into consideration in relation to the two production methods underlying FAP supply. Despite their synergy in achieving public health and resource conservation objectives (FAO, 2022), the issues behind farm production and wild catches differ, particularly from an environmental and health perspective (Gephart *et al.*, 2021; Golden *et al.*, 2021). Furthermore, our results indicate that a difference in consumer perception exists between the two productions. Wild products are perceived as being of higher quality, while aquaculture products are perceived as less healthy. Interestingly, these conflicting perceptions influence consumers' expectations of the sustainability of these two production processes in the literature. According to Zander and Feucht (2018a), French consumers associate sustainable fisheries mainly with environmental issues, while they associate sustainable aquaculture with more health and safety issues (use of hormones and drugs). This dichotomy is in line with Verbeke *et al.* (2007b), who show that consumers' refusal to consume wild products is mainly related to sustainability and ethical concerns. In contrast, the reasons for not eating aquaculture products are more related to health issues. To promote more sustainable FAP food systems while reassuring consumers regarding their perception, it is thus of paramount importance to promote the utilization of less impactful wild fishing methods (regarding endangered species and habitats) and less hormones and drugs using in aquaculture practices.

1.5.2.3 - The price barrier

According to our results, promoting the consumption of sustainable FAPs could face a significant barrier: the price of FAPs. This barrier may limit the effectiveness of promotion policies, especially among low-income populations, as also discussed by Koehn *et al.* (2020). However, in reality, this perception of FAPs requires nuancing. As with the meat sector, the price of FAPs varies greatly depending on the species consumed. On average, the FranceAgriMer report (FranceAgriMer, 2011) shows that FAPs are not always more expensive than meat. The French market currently favors expensive species such as cod and salmon, but there is a diversity of species available, leading to a range of prices similar to the meat sector. Considering the average price of fresh cod and salmon in 2022 (€ 20 per kilo), other species, such as fresh sardines (priced at €6.2 per kilo), mackerel (priced at €8.2 per kilo) and even spider crab (priced at €5.9 per kilo), are more affordable. Therefore, encouraging more diversified consumption and possibly "under-utilised" species with no identified market can also result in more diversified prices for consumers.

The question of price can also be approached through the prism of its distribution along the value chain. Indeed, there is a significant difference between the prices upstream in the value chain (landings, imports) and the final price for consumers on the French market, even for products that are not or hardly processed. According to FranceAgriMer, the average price of fish landings (mostly fresh) is €3.9 per kilo in 2022 and the average FAP import price is €6.0 per kilo (€7.3 per kilo for fresh products and €6.3 per kilo for frozen ones) (FranceAgriMer, 2023a). Thereafter, the final price for at-home consumption is €12.9 per kilo for fresh products, €11.4 per kilo for frozen products, €15.1 per kilo for delicatessen products and €10 per kilo for canned products (FranceAgriMer, 2023a). Efforts on the margins made by manufacturers could make certain FAPs more accessible to consumers. Moreover, reducing the consumption of delicatessen species can also be interesting for consumers' wallets. Nevertheless, as discussed for the diversification part, this value reallocation must consider the economic sustainability of fishing enterprises, notably producers (Koehn *et al.*, 2020).

**1.5.3 - Educating and informing consumers**

Globally, to promote new consumption behaviours, there is a need to increase citizens' knowledge of the FAP sector (Pieniak *et al.*, 2013, Almeida *et al.*, 2015), notably among the young and low-income populations. Indeed, knowledge is an important predictor of food consumption behaviour (Olsen, 2008) and an essential step for triggering behavioural changes (Teixeira and Silva, 2024). Interestingly, our results highlight that knowledge is linked to consumption regularity.

When they choose FAPs products, consumers tend to arbitrate between their own health and environmental health (Clonan *et al.*, 2012). To limit this trade-off situation, the message provided by the public authorities must be holistic and consistent with a healthy AND sustainable diet (Jacobs *et al.*, 2018). One example could be to integrate environmental considerations into nutritional recommendations (Tigchelaar *et al.*, 2022). This is also the position of several French institutional actors working on food issues (RéseauActionClimat, 2024). According

to this logic, the latest Nordic nutritional recommendations[18] have integrated environmental impacts into their nutritional recommendations. A list of sustainably managed species to consume according to seasonality could provide consumers with interesting additional information.

Following the nutritional recommendations provided by the Lancet (Willett *et al.*, 2019) could also be interesting. According to Springmann (2020), these recommendations are compatible with the objectives of a healthy and sustainable diet. They recommend a FAP consumption of 28g/day to achieve a healthy and green FAPs consumption, i.e. a weekly consumption of approximately 200g per capita. Although French dietary recommendations fall within this range, several European countries still recommend excessive consumption, underlining that some nutritional recommendations regarding FAPs are incompatible with protecting marine resources, as stated by Reynolds *et al.* (2014). Following this recommendation would result in an average per capita consumption of 20.3 kg of FAP per year[19], which is considerably below current average French consumption levels, leading to a decreasing global French FAP demand. This result underlines that a redistributive trend toward the segment of lower consumption is necessary to achieve fair and sustainable consumption of FAP products in France.

Information campaigns are another interesting tool to improve consumers' awareness of the sector and related issues. Such campaigns have the potential to reach a large portion of the population if the mass media support them, despite the long time needed to change current consumption behaviour (Teixeira and Silva, 2024). As discussed by Jacquet and Pauly (2007), the rise of media campaigns between the 1990s and 2000s helped to increase consumers' awareness regarding marine environment degradation. Nevertheless, between 2007 and 2015, 685 promotional campaigns were carried out in Europe to increase the consumption of FAPs, including 99 campaigns in France (EUMOFA, 2017). These French campaigns focused on the consumption of local species, the health and nutritional attributes of FAPs, and the promotion of Protected Geographical Indication (PGI) (EUMOFA, 2017). However, the "environmental dimension" was not clearly identified. Therefore, it is necessary to integrate this particular dimension more specifically in future campaigns. For instance, these campaigns could promote national species (as discussed above) that are managed sustainably. The latest IFREMER report (IFREMER, 2024) on the state of stocks exploited by the French fleets can provide interesting species to promote.

School and university canteens could provide a valuable network to promote healthy and sustainable food choices among young consumers. For instance, "Food education" is a key component of the objectives outlined in the French "National Food Programme (PNA)" for the period 2019-2023, although the place of FAPs is not clearly discussed. School canteens can democratize the consumption of these "under-utilised" domestic species. Classroom teaching can also be an interesting way to educate young people. (Teixeira and Silva, 2024). Restaurant chefs are also presented as a viable alternative to incite sustainable consumption behaviour (Teixeira

[18] More information on this recommendations: https://www.norden.org/en/publication/nordic-nutrition-recommendations-2023

[19] 28 g (Lancet daily recommendations) * 7 (number of days in a week) * 52 (number of weeks in a year) * 2 (average conversion rate for equivalent live weight)

and Silva, 2024). If we look at the French scale, an initiative like Ethic Ocean uses a network of restaurateurs to promote more sustainable consumption of FAPs. Finally, other information tools are being developed to help consumers make informed decisions about the health and environmental impact of their purchases (Marques *et al.*, 2021). An interesting example is the FishChoice[20] software. It provides consumers with information on the health and sustainability of the FAPs they consume. However, communication tools like this are often not visible to consumers and require research outside of in-store shopping time. To improve their effectiveness, there is a need to develop communication further.

### 1.5.4 - The potential of labelling policies

Although there are various ways of informing consumers (information campaigns, education in schools, etc.), food labels have emerged as an essential tool for achieving the EU's strategy for reforming food systems. These labels are now numerous in the FAP sector (Lucas *et al.*, 2021; Sonntag *et al.*, 2023), and they cover a wide range of FAP attributes. While the growth of labels in the FAPs market may point to a global improvement in the sector, this perception should be nuanced (Grunert *et al.*, 2014). Sonntag *et al.* (2023) speak about the "jungle" of labels in the FAP sector. This is highly problematic, as consumers may not have the expertise to distinguish between labels and make informed choices (Janßen and Langen, 2017). Label overlap, global confusion and trade-off situations result in growing consumer mistrust towards these labels (Grunert *et al.*, 2014; Sonntag *et al.*, 2023). Several papers have discussed the existing limitations of such initiatives, particularly with regard to consumer behaviour (Grunert, 2011; Grunert *et al.*, 2014; Annunziata *et al.*, 2019). Our results suggest that production methods (wild vs farmed) and the preference for artisanal productions influence consumer behaviours. Better understanding of the link between label valuation and these preferences could also be a promising lever for implementing more efficient policies.

## 1.6 - Conclusion

This article is part of a general ambition to examine the potential of FAPs in helping to achieve the global objective of "sustainable and healthy" diets. While FAPs represent an interesting alternative to meat consumption, their role remains under-discussed in existing public food policies. This article aimed to identify strategies for integrating FAPs more effectively in future policies and guide consumers towards sustainable FAPs consumption based on better understanding of their current behaviour. In order to achieve this objective, several data sources have been used. These include a literature review on the determinants of FAPs consumption, a national FAP consumer survey carried out in 2023 and aggregated public data on French FAPs consumption.

Firstly, we found that current French FAPs consumption relies on a few species, predominantly imported, and with issues regarding environmental and health attributes. Furthermore, this consumption is concentrated on a small subset of the French population. Regular consumers tend to be old, with objective knowledge of the sector and with high incomes. What is more, these frequent consumers tend to prefer fresh FAPs and artisanal fisheries. Finally, they do not perceive them as expensive and as difficult to cook. Globally, these results indicate that

[20] FishChoice is available at: www.fishchoice.eu

French consumption patterns are unfair and not aligned with the global objectives of environmental preservation and public health. These results confirm certain findings available at the EU level and in the existing literature. Furthermore, they provide additional knowledge and understanding of EU FAP consumers behaviours compared to this information available at present (FranceAgrimer in France and EUROBAROMETER for the EU).

Based on our findings, this article proposes a number of levers to guide consumers towards the sustainable consumption of FAPs. The initial step is to incorporate FAPs into existing food policies explicitly by promoting the diversity of FAPs (in species and according to production methods) plus "under-utilised" species from domestic small-scale fisheries managed sustainably. This strategy may assist in overcoming French dependency on imports and the price barrier, which represent a significant impediment to the consumption of FAPs. It is also consistent with the preferences expressed by regular French consumers regarding artisanal fisheries. Nevertheless, to change consumer behaviour, these policies need to be considered on a long-term basis. Moreover, they should aim to increase consumers' knowledge and awareness of FAPs.

Indeed, our result on the links between knowledge and frequency of consumption reveals the necessity to provide consumers with adequate information and education (through school education, information campaigns, chiefs and labels) in order to facilitate the transition to this dietary pattern, particularly among younger individuals and those with a low income. The inclusion of environmental information in nutritional guidance is also a crucial step (as exemplified by the Nordic countries and the Lancet) which could finally result in a reduction of global French FAP consumption, and lower pressure on exploited species.

Further research is needed following this work. First, there is a need to supplement our declarative data with real purchase data, notably regarding the frequencies of FAPs consumption. Moreover, the levers discussed imply an adaptation of the entire FAP supply chain on which few studies and research exist. The articles by Koehn *et al.* (2020) and Teixeira and Silva (2024) propose interesting insights regarding this (alternative FAPs networks, the importance of stakeholders' relationships, the implementation of new regulations governing these new channels, etc.). Finally, although consumers are key actors in our food system transition, the involvement of the production side remains essential, notably in identifying the incentives towards sustainable practices in the fishery and aquaculture sector.

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# 1.7 - Appendix

**Table 1.A1 - Questions used for measuring consumers' objective knowledge of the sector**

| Questions | Answers |
|---|---|
| The production method (wild or farmed) is mandatory information on seafood products sold fresh. | True |
| The quantity of OMEGA 3 present in fish does not depend on the species. | False |
| Cod and "Morue" are the same species | True |
| Haddock and hake are the same species | False |
| Saithe is a freshwater species | False |
| Oils and meals from wild fish are used as feed for farmed fish | True |
| As with fruit and vegetables, there are seasons for fish | True |
| Anchovies, mackerel and sardines belong to the family of small pelagic fish. | True |
| Monkfish can be described as an invasive species | False |
| The colour of a salmon fillet cannot be changed by its diet | False |
| In the wild, cod generally travel in shoals. | True |

Source - FORESEA 2050 database

**Table 1.A2 - Questions used for measuring consumers' preferences for FAPs**

| Questions |
|---|
| I buy fresh fish (whole or cut up) rather than canned, processed or frozen. |
| I take environmental issues into account when I buy WILD fish |
| I take environmental issues into account when I buy FARMED fish |
| It's important for me to know that my fish comes from France |
| I take health risks into account when I buy fish |

Source - FORESEA 2050 database

## 1.8 - References

**Ahern, M., Thilsted, S. H., & Oenema, S.** (2021). *The Role of Aquatic Food in Sustainable Healthy Diets - EAT* (Issue May). https://eatforum.org/learn-and-discover/aquatic-food-sustainable-healthy-diets/

**Alfnes, F., Chen, X., & Rickertsen, K.** (2018). Labeling farmed seafood: A review. *Aquaculture Economics and Management*, *22*(1), 1–26. https://doi.org/10.1080/13657305.2017.1356398

**Almeida, C., Altintzoglou, T., & Cabral, H.** (2015). Does seafood knowledge relate to more sustainable consumption ? *British Food Journal*, *117*(2), 894–914. https://doi.org/10.1108/BFJ-04-2014-0156

**Annunziata, A., A. Mariani, and R. Vecchio.** (2019). Effectiveness of sustainability labels in guiding food choices: Analysis of visibility and understanding among young adults. *Sustainable Production and Consumption*, (17):108–115. https://doi.org/10.1016/j.spc.2018.09.005

**Banovic, M., Reinders, M. J., Claret, A., Guerrero, L., & Krystallis, A.** (2019). A cross-cultural perspective on impact of health and nutrition claims, country-of-origin and eco-label on consumer choice of new aquaculture products. *Food Research International*, *123*(January), 36–47. https://doi.org/10.1016/j.foodres.2019.04.031

**Béné, C., Barange, M., Subasinghe, R., Pinstrup-Andersen, P., Merino, G., Hemre, G. I., & Williams, M.** (2015). Feeding 9 billion by 2050 – Putting fish back on the menu. Food Security, 7(2), 261–274. https://doi.org/10.1007/s12571-015-0427-z

**Béné, C., Oosterveer, P., Lamotte, L., Brouwer, I. D., de Haan, S., Prager, S. D., Talsma, E. F., & Khoury, C. K.** (2019). When food systems meet sustainability – Current narratives and implications for actions. *World Development*, *113*, 116–130. https://doi.org/10.1016/j.worlddev.2018.08.011

**Bennett, A., Basurto, X., Virdin, J., Lin, X., Betances, S. J., Smith, M. D., Allison, E. H., Best, B. A., Brownell, K. D., Campbell, L. M., Golden, C. D., Havice, E., Hicks, C. C., Jacques, P. J., Kleisner, K., Lindquist, N., Lobo, R., Murray, G. D., Nowlin, M., … Zoubek, S.** (2021). Recognize fish as food in policy discourse and development funding. *Ambio*, *50*(5), 981–989. https://doi.org/10.1007/s13280-020-01451-4

**Bimbo, F., Viscecchia, R., De Devitiis, B., Seccia, A., Roma, R., & De Boni, A.** (2022). How Do Italian Consumers Value Sustainable Certifications on Fish?—An Explorative Analysis. In *Sustainability* (Vol. 14, Issue 6). https://doi.org/https://doi.org/10.3390/su14063654

**Birch, D., & Lawley, M.** (2012). Buying seafood: Understanding barriers to purchase across consumption segments. *Food Quality and Preference*, *26*(1), 12–21. https://doi.org/https://doi.org/10.1016/j.foodqual.2012.03.004

**Brécard, D., Hlaimi, B., Lucas, S., Perraudeau, Y., & Salladarré, F.** (2009). Determinants of demand for green products: An application to eco-label demand for fish in Europe. *Ecological Economics*, *69*(1), 115–125. https://doi.org/10.1016/j.ecolecon.2009.07.017

**Brécard, D., Lucas, S., Pichot, N., & Salladarré, F.** (2012). Consumer preferences for eco, health and fair trade labels. An application to seafood products in France. *Journal of Agricultural and Food Industrial Organization*, *10*(1). https://doi.org/https://doi.org/10.1515/1542-0485.1360

**Brunsø, K., Hansen, K. B., Scholderer, J., Honkanen, P., Olsen, S. O., & Verbeke, W.** (2008). Consumer attitudes and seafood consumption in Europe. *Improving Seafood Products for the Consumer*, 16–39. https://doi.org/10.1533/9781845694586.1.16

**Brunsø, K., Verbeke, W., Olsen, S. O., & Jeppesen, L. F.** (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

**Cantillo, J., Martín, J. C., & Román, C.** (2021). Determinants of fishery and aquaculture products consumption at home in the EU28. *Food Quality and Preference*, *88*(May 2020). https://doi.org/10.1016/j.foodqual.2020.104085

**Cardoso, C., Lourenço, H., Costa, S., Gonçalves, S., & Nunes, M. L.** (2013). Survey into the seafood consumption preferences and patterns in the portuguese population. Gender and regional variability. *Appetite*, *64*, 20–31. https://doi.org/https://doi.org/10.1016/j.appet.2012.12.022

**Carlucci, D., Nocella, G., De Devitiis, B., Viscecchia, 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/https://doi.org/10.1016/j.appet.2014.10.008

**Claret, A., Guerrero, L., Aguirre, E., Rincón, L., Hernández, M. D., Martínez, I., Benito Peleteiro, J., Grau, A., & Rodríguez-Rodríguez, C.** (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

**Claret, A., Guerrero, L., Ginés, R., Grau, A., Hernández, M. D., Aguirre, E., Peleteiro, J. B., Fernández-Pato, C., & Rodríguez-Rodríguez, C.** (2014). Consumer beliefs regarding farmed versus wild fish. *Appetite*, *79*, 25–31. https://doi.org/10.1016/j.appet.2014.03.031

**Clonan, A., Holdsworth, M., Swift, J. A., Leibovici, D., & Wilson, P.** (2012). The dilemma of healthy eating and environmental sustainability: The case of fish. *Public Health Nutrition*, *15*(2), 277–284. https://doi.org/10.1017/S1368980011000930

**Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F. N., & Leip, A.** (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*, *2*(3), 198–209. https://doi.org/10.1038/s43016-021-00225-9

**Crona, B. I., Wassénius, E., Jonell, M., Koehn, J. Z., Short, R., Tigchelaar, M., Daw, T. M., Golden, C. D., Gephart, J. A., Allison, E. H., Bush, S. R., Cao, L., Cheung, W. W. L., DeClerck, F., Fanzo, J., Gelcich, S.,**

**Kishore, A., Halpern, B. S., Hicks, C. C., … Wabnitz, C. C. C.** (2023). Four ways blue foods can help achieve food system ambitions across nations. *Nature*, *616*(7955), 104–112. https://doi.org/https://doi.org/10.1038/s41586-023-05737-x

**Dewals, J.-F., Le Floc'h, P., Daurès, F., & Lucas, S.** (2024). La place des consommateurs dans les dynamiques territoriales de connaissance : le cas des produits de la mer. *Revue d'économie Régionale et Urbaine*.

**EU Food Policy Coalition.** (2021). *Discovering the role of Food Environments for sustainable food systems* (Issue October). https://foodpolicycoalition.eu/wp-content/uploads/2021/10/Food-Environments-for-SFS_EU-FPC.pdf

**EUMOFA.** (2017). *EU consumer habits regarding fishery and aquaculture products. Annex 3, Mapping of national campaigns* (Issue January). https://data.europa.eu/doi/10.2771/87688

**EUMOFA.** (2022). *The EU fish market – 2022 edition*. https://doi.org/10.2771/716731

**European Commission.** (2021a). *EU Agricultural Outlook For Markets And Income 2018-2030*. https://doi.org/10.2762/753688

**European Commission.** (2021b). EU consumer habits regarding fishery and aquaculture products. In *Special Eurobarometer 151* (Issue April). https://europa.eu/eurobarometer/surveys/detail/2271

**FAO.** (2022). *The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation*. https://doi.org/https://doi.org/10.4060/cc0461en

**FAO, IFAD, UNICEF, WFP, & WHO.** (2022). *The state of food security and nutrition in the World - 2022*. https://doi.org/https://doi.org/10.4060/cc0639en

**Farmery, A. K., van Putten, I. E., Phillipov, M., & McIlgorm, A.** (2020). Are media messages to consume more under-utilized seafood species reliable? *Fish and Fisheries*, *21*(4), 844–855. https://doi.org/https://doi.org/10.1111/faf.12467

**Feucht, Y., & Zander, K.** (2017). *Deliverable : D2 . 2 - Results on consumer preferences for sustainable seafood products from Europe* (Issue September). https://cordis.europa.eu/project/id/635188/results

**FranceAgriMer.** (2011). *Les synthèses de FranceAgriMer - Poisson ou viande, est-ce seulement une question de prix ?*https://www.franceagrimer.fr/filiere-viandes/Les-dernieres-mises-en-ligne?mise_en_ligne%5BfiltreTypeContenu%5D=analyse&page=10

**FranceAgriMer.** (2021). *Consumption of meat products in 2021*. https://www.franceagrimer.fr/filiere-viandes/Viandes-rouges/Eclairer/Etudes-et-Analyses/Chiffres-et-bilans

**FranceAgriMer.** (2023a). Consommation des produits de la pêche et de l'aquaculture 2022. In *Données et bilans de l'Etablissement national des produits de l'agriculture et de la mer*.

**FranceAgriMer.** (2023b). *The fisheries and aquaculture sector in France (2023)*. https://www.franceagrimer.fr/fam/content/download/67049/document/STA_MER_chiffres_cles_english.pdf?version=2

**Gephart, J. A., Henriksson, P. J. G., Parker, R. W. R., Shepon, A., Gorospe, K. D., Bergman, K., Eshel, G., Golden, C. D., Halpern, B. S., Hornborg, S., Jonell, M., Metian, M., Mifflin, K., Newton, R., Tyedmers, P., Zhang, W., Ziegler, F., & Troell, M.** (2021). Environmental performance of blue foods. *Nature*, *597*(7876), 360–365. https://doi.org/10.1038/s41586-021-03889-2

**Golden, C. D., Koehn, J. Z., Shepon, A., Passarelli, S., Free, C. M., Viana, D. F., Matthey, H., Eurich, J. G., Gephart, J. A., Fluet-Chouinard, E., Nyboer, E. A., Lynch, A. J., Kjellevold, M., Bromage, S., Charlebois, P., Barange, M., Vannuccini, S., Cao, L., Kleisner, K. M., … Thilsted, S. H.** (2021). Aquatic foods to nourish nations. *Nature*, *598*(7880), 315–320. https://doi.org/10.1038/s41586-021-03917-1

**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. https://doi.org/10.1017/S0007114520003773

**Greene, W.** (2018). *Econometric Analysis - 8th Edition* (Pearson (ed.); 8th ed.). Pearson Education Limited.

**Grunert, K. G.** (2011). Sustainability in the Food Sector: A Consumer Behaviour Perspective. *International Journal on Food System Dynamics*, *2*(3), 207–218. https://doi.org/10.18461/ijfsd.v2i3.232

**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

**Hallström, E., Bergman, K., Mifflin, K., Parker, R., Tyedmers, P., Troell, M., & Ziegler, F.** (2019). Combined climate and nutritional performance of seafoods. *Journal of Cleaner Production*, *230*, 402–411. https://doi.org/10.1016/j.jclepro.2019.04.229

**Heutte, K., Daures, F., Lucas, S., Girard, S., Alban, F., & Le Floc'h, P.** (2023). Fisheries and aquaculture products consumption in France: when the Covid-19 crisis did not lead to more sustainable purchases. *Aquatic Living Resources*, *36*(10), 19p. https://doi.org/https://doi.org/10.1051/alr/2023004

**IFREMER**. (2024). *Bilan 2023 du statut des ressources halieutiques débarquées par la pêche française hexagonale en 2022*. https://archimer.ifremer.fr/doc/00877/98852/

**IPBES**. (2019). *Global assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. https://ipbes.net/global-assessment%0Ahttps://ipbes.net/global-assessment-report-biodiversity-ecosystem-services

**Irz, X., Leroy, P., Réquillart, V., & Soler, L. G.** (2018). Fish in climate-friendly and healthy diets. *Marine Resource Economics*, *33*(4), 319–330. https://doi.org/10.1086/699882

**Ivanova, O., Flores-Zamora, J., Khelladi, I., & Ivanaj, S.** (2019). The generational cohort effect in the context

of responsible consumption. *Management Decision*, *57*(5), 1162–1183. https://doi.org/https://doi.org/10.1108/MD-12-2016-0915

**Jacobs, S., Sioen, I., Pieniak, Z., De Henauw, S., Maulvault, A. L., Reuver, M., Fait, G., Cano-Sancho, G., & Verbeke, W.** (2015). Consumers' health risk-benefit perception of seafood and attitude toward the marine environment: Insights from five European countries. *Environmental Research*, *143*(B), 11–19. https://doi.org/https://doi.org/10.1016/j.envres.2015.02.029

**Jacobs, S., Sioen, I., Marques, A., & Verbeke, W.** (2018). Consumer response to health and environmental sustainability information regarding seafood consumption. *Environmental Research*, *161*(October 2017), 492–504. https://doi.org/10.1016/j.envres.2017.10.052

**Jacquet, J. L., & Pauly, D.** (2007). The rise of seafood awareness campaigns in an era of collapsing fisheries. *Marine Policy*, *31*(3), 308–313. https://doi.org/10.1016/j.marpol.2006.09.003

**Jahns, L., Raatz, S. K., Johnson, L. A. K., Kranz, S., Silverstein, J. T., & Picklo, M. J.** (2014). Intake of seafood in the US varies by age, income, and education level but not by race-ethnicity. *Nutrients*, *6*(12), 6060–6075. https://doi.org/10.3390/nu6126060

**Janßen, D., & Langen, N.** (2017). The bunch of sustainability labels – Do consumers differentiate? *Journal of Cleaner Production*, *143*, 1233–1245. https://doi.org/10.1016/j.jclepro.2016.11.171

**Koehn, J. Z., Quinn, E. L., Otten, J. J., Allison, E. H., & Anderson, C. M.** (2020). Making seafood accessible to low-income and nutritionally vulnerable populations on the U.S. West Coast. Journal of Agriculture, Food Systems, and Community Development, 10(1), 171–189. https://doi.org/10.5304/jafscd.2020.101.027

**Koehn, J. Z., Allison, E. H., Golden, C. D., & Hilborn, R.** (2022). The role of seafood in sustainable diets. *Environmental Research Letters*, *17*(3). https://doi.org/10.1088/1748-9326/ac3954

**López-Mas, L., Claret, A., Reinders, M. J., Banovic, M., Krystallis, A., & Guerrero, L.** (2021). Farmed or wild fish? Segmenting European consumers based on their beliefs. *Aquaculture*, *532*(June 2020), 735992. https://doi.org/10.1016/j.aquaculture.2020.735992

**Lucas, S., Soler, L.-G., & Revoredo-Giha, C.** (2021). Trend analysis of sustainability claims: The European fisheries and aquaculture markets case. *Food Policy*, *104*(July), 102141. https://doi.org/https://doi.org/10.1016/j.foodpol.2021.102141

**Maesano, G., Di Vita, G., Chinnici, G., Pappalardo, G., & D'Amico, M.** (2020). The Role of Credence Attributes in Consumer Choices of Sustainable Fish Products: A Review. In *Sustainability* (Vol. 12, Issue 23). https://doi.org/10.3390/su122310008

**Marinac Pupavac, S., Kenđel Jovanović, G., Linšak, Ž., Glad, M., Traven, L., & Pavičić Žeželj, S.** (2022). The influence on fish and seafood consumption, and the attitudes and reasons for its consumption in the Croatian population. In *Frontiers in Sustainable Food Systems* (Vol. 6).

https://doi.org/https://doi.org/10.3389/fsufs.2022.945186

**Marquès, M., Torres, C. M., García-fern, F., Mantur-vierendeel, A., Roe, M., Wilson, A. M., Reuver, M., & Nadal, M.** (2021). FishChoice 2 . 0 : Information on health benefits / risks and sustainability for seafood consumers. *Food and Chemical Toxicology*, *155*(March). https://doi.org/10.1016/j.fct.2021.112387

**Menozzi, D., Wongprawmas, R., Sogari, G., Gai, F., Parisi, G., & Mora, C.** (2023). The role of objective and subjective knowledge on the attitude and intention of Italian consumers to purchase farmed and wild fish. *Agricultural and Food Economics*, *11*(1), 1–25. https://doi.org/10.1186/s40100-023-00288-1

**Milford, A. B., & Muiruri, S. W.** (2024). The impact of consumers' preferences for domestic food on dietary sustainability. *Appetite*, *195*, 107206. https://doi.org/10.1016/j.appet.2024.107206

**Murray, G., Wolff, K., & Patterson, M.** (2017). Why eat fish? Factors influencing seafood consumer choices in British Columbia, Canada. *Ocean and Coastal Management*, *144*(October), 16–22. https://doi.org/10.1016/j.ocecoaman.2017.04.007

**Naylor, R. L., Kishore, A., Sumaila, U. R., Issifu, I., Hunter, B. P., Belton, B., Bush, S. R., Cao, L., Gelcich, S., Gephart, J. A., Golden, C. D., Jonell, M., Koehn, J. Z., Little, D. C., Thilsted, S. H., Tigchelaar, M., & Crona, B.** (2021). Blue food demand across geographic and temporal scales. *Nature Communications*, *12*(1), 1–14. https://doi.org/https://doi.org/10.1038/s41467-021-25516-4

**Olsen, S. O.** (2003). Understanding the relationship between age and seafood consumption: The mediating role of attitude, health and involvement and convenience. *Food Quality and Preference*, *14*(3), 199–209. https://doi.org/10.1016/S0950-3293(02)00055-1

**Olsen, S. O.** (2008). Antecedents of Seafood Consumption Behaviour. *Journal of Aquatic Food Product Technology*, *13*(3), 79–91. https://doi.org/10.1300/J030v13n03

**Overall, J. E., Atlas, R. S., & Gibson, J. M.** (1995). Tests That are Robust against Variance Heterogeneity in k × 2 Designs with Unequal Cell Frequencies. *Psychological Reports*, *76*(3), 1011–1017. https://doi.org/10.2466/pr0.1995.76.3.1011

**Perignon, M., Vieux, F., Soler, L. G., Masset, G., & Darmon, N.** (2017). Improving diet sustainability through evolution of food choices: Review of epidemiological studies on the environmental impact of diets. *Nutrition Reviews*, *75*(1), 2–17. https://doi.org/10.1093/nutrit/nuw043

**Pieniak, Z., Verbeke, W., Olsen, S. O., Hansen, K. B., & Brunsø, K.** (2010). Health-related attitudes as a basis for segmenting European fish consumers. *Food Policy*, *35*(5), 448–455. https://doi.org/10.1016/j.foodpol.2010.05.002

**Pieniak, Z., Vanhonacker, F., & Verbeke, W.** (2013). Consumer knowledge and use of information about fish and aquaculture. *Food Policy*, *40*, 25–30. https://doi.org/https://doi.org/10.1016/j.foodpol.2013.01.005

**RéseauActionClimat**. (2024). Comment concilier nutrition et climat ?. https://librairie.ademe.fr/7149-comment-

concilier-nutrition-et-climat-.html

**Reynolds, C. J., Buckley, J. D., Weinstein, P., & Boland, J.** (2014). Are the dietary guidelines for meat, fat, fruit and vegetable consumption appropriate for environmental sustainability? A review of the literature. *Nutrients*, *6*(6), 2251–2265. https://doi.org/10.3390/nu6062251

**Rickertsen, K., Alfnes, F., Combris, P., Enderli, G., Issanchou, S., & Shogren, J. F.** (2017). French Consumers' Attitudes and Preferences Toward Wild and Farmed Fish. *Marine Resource Economics*, *32*(1), 59–81. https://doi.org/10.1086/689202

**Salladarré, F., Guillotreau, P., Perraudeau, Y., & Monfort, M. C.** (2010). The demand for seafood eco-labels in France. *Journal of Agricultural and Food Industrial Organization*, *8*(1). https://doi.org/10.2202/1542-0485.1308

**Santeramo, F. G., Carlucci, D., De Devitiis, B., Seccia, A., Stasi, A., Viscecchia, R., & Nardone, G.** (2018). Emerging trends in European food, diets and food industry. *Food Research International*, *104*(November), 39–47. https://doi.org/10.1016/j.foodres.2017.10.039

**Sonntag, W. I., Lemken, D., Spiller, A., & Schulze, M.** (2023). Welcome to the (label) jungle? Analyzing how consumers deal with intra-sustainability label trade-offs on food. *Food Quality and Preference*, *104*(October 2022). https://doi.org/10.1016/j.foodqual.2022.104746

**Springmann, M.** (2020). Valuation of the health and climate-change benefits of healthy diets. In *FAO Agricultural Development Economics Working Paper 20-03* (Issue October). https://doi.org/10.4060/cb1699en

**Szolnoki, G., & Hoffmann, D.** (2014). Consumer segmentation based on usage of sales channels in the German wine market. *International Journal of Wine Business Research*, *26*(1), 27–44. https://doi.org/10.1108/IJWBR-10-2012-0028

**Teixeira, C. M., & Silva, P. M.** (2024). The huge dilemma: how to increase seafood consumption for health benefits without impacting fisheries' sustainability? *International Journal of Food Science and Technology*, *59*(2), 661–672. https://doi.org/10.1111/ijfs.16841

**Thong, N. T., & Solgaard, H. S.** (2017). Consumer's food motives and seafood consumption. *Food Quality and Preference*, *56*(October), 181–188. https://doi.org/10.1016/j.foodqual.2016.10.008

**Tigchelaar, M., Leape, J., Micheli, F., Allison, E. H., Basurto, X., Bennett, A., Bush, S. R., Cao, L., Cheung, W. W. L., Crona, B., DeClerck, F., Fanzo, J., Gelcich, S., Gephart, J. A., Golden, C. D., Halpern, B. S., Hicks, C. C., Jonell, M., Kishore, A., … Wabnitz, C. C. C.** (2022). The vital roles of blue foods in the global food system. *Global Food Security*, *33*, 100637. https://doi.org/https://doi.org/10.1016/j.gfs.2022.100637

**Uchida, H., Onozaka, Y., Morita, T., & Managi, S.** (2014). Demand for ecolabeled seafood in the Japanese market: A conjoint analysis of the impact of information and interaction with other labels. *Food Policy*, *44*, 68–76. https://doi.org/10.1016/j.foodpol.2013.10.002

**Verbeke, W., Sioen, I., Pieniak, Z., Van Camp, J., & De Henauw, S.** (2005). Consumer perception versus scientific evidence about health benefits and safety risks from fish consumption. *Public Health Nutrition*, *8*(4), 422–429. https://doi.org/10.1079/phn2004697

**Verbeke, W., Sioen, I., Brunsø, K., Henauw, S., & Camp, J.** (2007a). Consumer perception versus scientific evidence of farmed and wild fish: Exploratory insights from Belgium. *Aquaculture International*, *15*(2), 121–136. https://doi.org/10.1007/s10499-007-9072-7

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

**Vieux, F., Perignon, M., Gazan, R., & Darmon, N.** (2018). Dietary changes needed to improve diet sustainability: Are they similar across Europe? *European Journal of Clinical Nutrition*, *72*(7), 951–960. https://doi.org/10.1038/s41430-017-0080-z

**Waley, D., Harris, M., Goudling, I., & Correira, M.** (2021). Catching up: Fish Welfare in Wild Capture Fisheries. In *Eurogroup for Animals* (Issue January). https://www.eurogroupforanimals.org/library/catching-fish-welfare-wild-capture-fisheries

**Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., … Murray, C. J. L.** (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, *393*(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

**Zander, K., & Feucht, Y.** (2018a). Consumers' Willingness to Pay for Sustainable Seafood Made in Europe. *Journal of International Food and Agribusiness Marketing*, *30*(3), 251–275. https://doi.org/https://doi.org/10.1080/08974438.2017.1413611

**Zander, K., Risius, A., Feucht, Y., Janssen, M., & Hamm, U.** (2018b). Sustainable Aquaculture Products: Implications of Consumer Awareness and of Consumer Preferences for Promising Market Communication in Germany. *Journal of Aquatic Food Product Technology*, 27(1), 5–20. https://doi.org/10.1080/10498850.2017.1390028

# Chapter 2: Assessment of consumer preferences in the context of multiple labels: the case of Fishery and Aquaculture Products

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**Abstract**

Purpose: Labels are currently numerous and diverse in the Fishery and Aquaculture Products (FAPs) market, providing consumers with information about the different attributes of FAPs. This extensive development implies that consumers have to face trade-off situations. This paper aims: 1) to identify which labels are most valued by consumers when they face a trade-off situation, 2) to study the consumption profiles behind these preferences, and 3) to suggest ways of improving the efficiency of labelling policies.

Methods: Based on a survey conducted in 2021 (n = 1 427), this article describes FAPs consumers' preferences for labelled FAPs. To do so, each consumer was asked to rank their favourite scheme from a pool of nine hypothetical labels related to specific FAPs characteristics. Then, we used a Mixed Multinomial Logit Model (MMLM) with marginal effects to analyse consumption profiles.

Results: Our results show heterogeneity among consumers regarding labelled FAPs. Overall, labels that ensure intrinsic qualities remain preferred to labels linked to ethical considerations. Moreover, while preferences for domestic productions are prominent, there is a very wide gap with real purchasing behaviour. Furthermore, this study shows that personal motivation, age, gender, knowledge or place of residence influence the preferences expressed.

Conclusion: Labels are a policy tool used to reform the FAPs value chain. Nevertheless, they are struggling to achieve their objectives. Our results can be useful for better targeting the messages to be implemented, improving the efficiency of labelling policies and helping consumers to make informed and sustainable choices.

**Keywords:** Multiple choices, labelling schemes, consumers' preferences, seafood, France, Multinomial Mixed Logit Model.

**JEL Codes:** D12, Q22, Q56

## 2.1 - Introduction

Our food systems are facing multiple challenges that question their ability to provide healthy and sustainable food for a growing world population. As a result, significant efforts are underway to reform our modes of production and consumption of food products. While public policies have initially focused on the productive sphere, consumers are now recognised as a driving force that is able to transform our food value chains (Brunin *et al.*, 2022). Over the last few years, the concept of "sustainable consumption" has become widely disseminated (Santeramo *et al.*, 2018). It lies at the heart of the United Nation's sustainable development programme via goal 12: "Ensure sustainable consumption and production patterns"[21]. At the EU scale, the "From Farm to Fork" strategy also promotes this policy goal. In order to guide consumers towards sustainable consumption choices, policymakers promote, among other things, new information tools such as labelling schemes. To make our food systems more sustainable, it is therefore essential to understand how consumers position themselves concerning these labelling initiatives.

These labels can take varied forms, as shown by the definition adopted by the Food and Agriculture Organization (FAO): "*A food label is any tag, brand, mark, pictorial or other descriptive matter, written, printed, stencilled, marked, embossed or impressed on, or attached to, a container of food or food product*". Labels are currently highly developed in the food market (Caswell and Mojduszka, 1996). A study launched in 2013 by the EU Commission already counted over 900 food labels[22] in the EU, where producers are key actors in this expansion. In a globalised food market, labels are a means of differentiating products from competition. Unfortunately, this may lead to dubious labels with varying expectations and constraints, allowing for artificial changes in the perceived value. Consequently, this potential information asymmetry could lead to increasing distrust among consumers.

The global expression "label jungle" (Sonntag *et al.*, 2023) captures the negative sides of this label expansion. This includes a loss of meaning of labels, growing confusion, overlap risks and even difficult trade-off situations for consumers. Indeed, labels can cover a wide range of product attributes (Gracia and De-Magistris, 2016) through different certification methods, criteria, etc. From a theoretical point of view, labels transform credence attributes (Nelson, 1970; Darby and Karni, 1973) into search attributes for consumers (Roe and Sheldon, 2007) and reduce asymmetric information between producers and consumers. Credence attributes are attributes (Lancaster, 1966) for which the marginal cost of seeking information exceeds the associated marginal benefit, both before and after consumption. In other words, their presence in the product is difficult for the consumer to assess, even after consumption. Labels, therefore, remain the only source of information that allows consumers to consider this dimension in their consumption preferences. However, labels typically focus on a single product attribute, such as environmental impact, safety or animal welfare. When making consumption choices, consumers

[21] More information on this sustainable development goal can be found at https://sdgs.un.org/goals/goal12
[22] Survey IPSOS: Consumer market Study on the functioning of voluntary food labelling schemes for consumers in the European Union EAHC/ FWC/2012 86 04

will thus encounter some trade-off situations

The FAPs (Fishery and Aquaculture Products) market is a highly "label-dependent" market (Washington, 2008; Fonner and Sylvia, 2015). This dependence is explained by the presence of credence attributes in FAPs (Sogn-Grundvag *et al.*, 2014), notably valued by consumers in the context of responsible consumption. Today, different labels coexist in this market to inform consumers about these attributes. It includes labels related to FAPs production methods, FAPs quality, FAPs origin, FAPs welfare, etc. Interestingly, trade-off consuming situations described earlier are thus prevalent (Sonntag *et al.*, 2023).

While the sustainability of the FAPs sector is a major challenge (Tigchelaar *et al.*, 2022), it is essential to understand how consumers position themselves regarding these multiple labelling schemes and possible trade-off situations. This is of interest to public decision-makers or even to the industry. Although the existing literature often focuses on understanding the preferences for a single label (Johnston *et al.*, 2001; Brécard *et al.*, 2009; Salladarré *et al.*, 2010; Uchida *et al.*, 2014; Weitzman and Bailey, 2018), or a limited number of labels (Brécard *et al.*, 2012; Banovic *et al.*, 2019), to our knowledge, available research has rarely investigated these expressed preferences for a large pool of alternatives. However, Fonner and Sylvia (2015), Gracia and De-Magistris (2016), and Maesano *et al.* (2019) pointed out that there is a need to understand better how consumers interact with these multiple choices inside the food market. This article seeks to fill this gap. It proposes to refine the knowledge on consumers' preferences for labelled FAPs *via* a choice situation towards ten hypothetical alternatives (see Section 2). This approach tries to bring consumers closer to their current trade-off situations. The aim of this article is to:

- Study the most preferred labelling schemes by FAPs consumers in a framework close to real choice by allowing preferences to vary across ten alternatives ;
- Study the consumption profiles behind these expressed preferences ;
- Propose public policy recommendations regarding FAPs to orient the sector towards greater sustainability.

Our case study will be the French FAPs market, a market particularly dependent on labelling schemes (FranceAgrimer, 2019). Indeed, labels have quickly expanded in the last decades (Organic, Protected Geographical Indication, *Label Rouge*, etc.) and cover a wide range of FAPs' attributes (production methods, origin, quality, animal welfare, etc.). The different features of this market may explain this noteworthy development. First, regarding consumption habits, it seems French consumers purchase more and more processed FAPs (FranceAgriMer, 2021a). These products are described as low quality (Ahern *et al.*, 2021), whose consumption can impact consumers' health. This may therefore motivate a demand for information regarding FAP's quality, health or even nutritional aspects. Second, a large share of domestic catches and supplies originate from production methods with high environmental impacts (trawling, intensive aquaculture, etc.) (STECF, 2020). This may explain the emergence of an ethical demand and associated ecolabels in the French FAPs market (Lucas *et al.*, 2021). Furthermore, this market is highly dependent on imports. In 2018, France imported 2,078 thousand tons of FAPs (FranceAgriMer, 2021b), i.e., more than 2/3 of French consumption. While French consumers are

increasingly concerned about the origin of their food, traceability in the FAPs sector is highly problematic (Crona *et al.*, 2016; Lewis and Boyle, 2017), leading to the development of geographical origin labels. Finally, the "Fair Trade" trend is growing in importance for food demand (Rousseau, 2015; Clark *et al.*, 2017). As a credence attribute, consumers would value further information, creating a possible demand for related labels in the FAPs sector.

The paper is structured as follows. Section 2 will introduce the database and the methodology used to analyse the stated preferences. Section 3 will present results regarding the preferences of French consumers for labelled FAPs. Section 4 will discuss our results, provide recommendations regarding public policies and suggest further research.

## 2.2 - Materials and methods

### 2.2.1 - Data

The database used in this article stems from a FAPs consumer survey carried out between April and May 2021 on the French market (noted COPECO-Covid-RCN database) in the framework of two research programmes: a French research programme, COPECO[23], and a Norwegian research programme, COVID-RCN[24] . This survey had two objectives: 1) to measure the impact of the COVID crisis on FAP consumption and 2) to study the preferences of French consumers concerning labelled FAPs. The survey was performed online and administered by KantarWorldPanel to 1,504 FAPs consumers. The quotas method was applied to obtain a representative sample of the French population regarding age and gender. After processing and analysing responses, we selected a sample of 1,427 individuals. Table 2.1 presents the socio-demographic characteristics of this sample.

This survey is broken down into five sections for a total of 57 questions: 1) food consumption habits (including during the COVID crisis); 2) FAPs consumption and purchasing behaviour; 3) consumer preferences for FAPs; 4) motivations, knowledge and implications of FAP consumers; and, lastly, 5) socio-demographic characteristics. In this article, we focus on questions relating to consumption habits (Section 2), preferences expressed regarding labelled FAPs (section 3), Schwartz values (Schwartz, 1992; Schwartz, 2012) (Section 4) and the socio-demographic section (Section 5).

[23]For more information on this research programme: https://www.umr-amure.fr/projets-scientifiques/projet_copeco/
[24]For more information on this research programme: https://www.forskningsradet.no/en/

**Table 2.1 - Characteristics of the sample (n = 1,427 obs)**

| | Sample | | France[1] | |
|---|---|---|---|---|
| **Gender (%)** | Male | Female | Male | Female |
| | 48.8 | 51.2 | 48.3 | 51.7 |
| **Socio-Professional Category (%)** | | | | |
| Farmers | 0.2 | | 0.8 | |
| Artisans, retailers and business owners | 2.9 | | 3.5 | |
| Managers and higher intellectual professions | 11.6 | | 9.5 | |
| Intermediate professions | 13.9 | | 14.1 | |
| Employees | 26.9 | | 16.1 | |
| Workers | 4.6 | | 12.1 | |
| Retirees | 28.3 | | 26.9 | |
| Other non-working people | 11.6 | | 17.0 | |
| **Age categories (%)** | | | | |
| [18-34] | 23.9 | | 22.6 | |
| [35-49] | 25.1 | | 24.9 | |
| [50-64] | 25.8 | | 25.2 | |
| [65+] | 25.2 | | 27.2 | |

Source - COPECO/RCN survey - 2021

[1]INSEE, data from 2021

*Note: As we included only FAPs consumers, the under-representation of the socio-professional category "Farmers and Workers" can be explained by the negative correlation between the level of education and FAPs consumption (Hicks et al., 2008).*

To study consumers' preferences for labelled FAPs, we asked the respondents to rank their three favourite labels from a choice of ten hypothetical alternatives (section 3). Here, we decided to focus solely on the first expressed preference, as it represents the label consumers prioritise. Moreover, we have deliberately chosen to work on hypothetical schemes, not existing ones. Therefore, each label in our survey was presented to consumers by a specific definition, not by an existing brand. The purpose was to avoid "anchoring bias" related to brand recognition. This allows us to study preferences for the attribute labelled rather than a preference for the label itself. Indeed, according to the results of the FranceAgriMer survey (2019), it seems that this anchoring bias is apparent in the French FAP market. The selected labels may already exist on the French FAP market (ecolabels, origin labels, animal-welfare labels, nutrition claims and quality labels) or may respond to global food market trends (the Fair-Trade label is not currently available for FAPs, and the health claim remains fictional[25]). This choice brings consumers closer to a real trade-off situation (*ceteris paribus*). These labels and their definitions

[25] Despite their absence in the FAPs market, more and more initiatives are being developed in the food industry concerning health information.

are presented in Table 2.2.

**Table 2.2 - Definition of the labels used**

| Labels | Definition |
|---|---|
| Animal Welfare | Identify FAPs that respect animal welfare throughout the production process |
| Ecolabel | Identify FAPs that respect the environment and resources |
| Fair-Trade | Identify FAPs that guarantee a minimum income for producers and good working conditions |
| Local origin | Identify FAPs produced in your region |
| France origin | Identify FAPs produced in France (except your region) |
| EU origin | Identify FAPs from European fisheries and aquaculture (except France) |
| Safety | Identify FAPs that do not contain toxic substances |
| Nutrition | Identify the nutritional content of FAPs (less salt, rich in omega 3, etc.) |
| Quality | Identify FAPs with a higher quality level than other products in the category |

Source - COPECO/RCN survey – 2021

### 2.2.2 - Method

2.2.2.1 -Variance and Means Comparison Tests

We wanted to test whether the preferences declared for one label are statistically lower or higher than those declared for another. Two statistical tests were performed. First, an F-test to measure the equality of variances between the means. If the equality of variances of the means is not rejected, a Student t-test is used. Otherwise, the Welch t-test should provide more accurate results (Overall *et al.*, 1995).

$$t_{Student} = \frac{\bar{X}_1 - \bar{X}_2}{s_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} \text{ with } s_p = \sqrt{\frac{(n_1-1)s_{X_1}^2+(n_2-1)s_{X_2}^2}{n_1+n_2-2}} \quad (1)$$

$$t_{Welch} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{N_1}+\frac{s_2^2}{N_2}}} \text{ with } s_{\bar{X}_1} = \frac{s_1}{\sqrt{n1}} \text{ and } s_{\bar{X}_2} = \frac{s_2}{\sqrt{n2}} \quad (2)$$

With $\bar{X}_n$ the mean to compare, $s_n$ the sample means' standard deviations and $n_n$ the sample sizes.

For these two tests, if the null hypothesis (H0) is not rejected, we should conclude to an equality of means. If not, the means are statistically different.

2.2.2.2 - Mixed Multinomial Logit (MMNL) Model

The model used is based on Lancaster's theory (Lancaster, 1966) and the random utility theory (McFadden, 1974). Consumers are assumed to compare alternatives and choose the alternative with the highest level of utility. The utility *U* of alternative *a* obtained in a choice situation *t* by consumers *i* is therefore given by:

$$U_{ait} = V_{ait} + \varepsilon_{ait} \quad (3)$$

We used a Mixed Multinomial Logit (MMNL) model to analyse consumer preferences for labelled FAPs.

As McFadden and Train (2000) discussed, this model efficiently represents an economic discrete choice. The MMNL is an extension of the Multinomial Logit Model (MLM). Compared to a conventional MLM, the MMNL model relaxes the independence of the Irrelevant Alternatives Assumption (IAA) (McFadden and Train, 2000). The MMNL fits with choice data in which individuals make choices across unordered options and includes attributes that vary between individuals (such as income, age, etc.). It uses random coefficients to model the correlation of choices across alternatives. The mixed logit models are commonly used in choice literature (Bhat and Gossen, 2004), including for labelling schemes (Bonnet and Simioni, 2001; Gracia and De Magistris, 2016).

In our case, consumers select the label with the highest perceived utility. For the mixed logit model, a standard representation of the utility that individual *i* receives from alternatives *a*, *a* = 1, 2,..., 10 denoted by $U_{ia}$ is:

$$U_{ia} = x_{ia}\beta_i + \omega_{ia}\alpha + z_i\delta_a + \epsilon_{ia} \quad (4)$$

$\beta_i$ are random coefficients that vary across individuals in our sample, and $x_{ia}$ is a vector of case-specific variables. $\alpha$ is a fixed coefficient from $\omega_{ia}$ a vector of alternative-specific variables. $\delta_a$ are fixed alternative-specific coefficients, and zi is a vector of case-specific variables. $\varepsilon_{ia}$ is a random term. Our model does not include alternative-specific variables. The probability that case *i* chooses alternative *a* regarding the random parameter $\beta_i$ is:

The probability that case *i* chooses alternative *a* regarding the random parameter $\beta_i$ is:

$$Y = P_{ia}(\beta) = \frac{e^{x_{ia}\beta_i + w_{ia}\alpha + z_i\delta_a}}{\sum_{a=1}^{A} e^{x_{ia}\beta_i + w_{ia}\alpha + z_i\delta_a}} \quad (5)$$

We end up with a variable to be explained Y = 1 if the individual has ranked the label concerned at first in his/her preference. Otherwise, Y = 0.

2.2.2.3 - Explanatory variables included in our model

The existing literature focusing on FAPs consumers' preferences for labelling schemes (Wessells *et al.*, 1999; Johnston *et al.*, 2001: Jaffry *et al.*, 2004; Salladarré *et al.*, 2010; Brécard *et al.*, 2009; Brécard *et al.*, 2012; Weitzman and Bailey, 2018; Zander and Feucht, 2018; Maesano *et al.*, 2019; Maesano *et al.*, 2020; Zander *et al.*, 2022) was consulted to identify variables to be included in our model. However, some explanatory variables used can differ among articles, and several models could have been estimated in our framework. To compare these different models, measure their performances, and select the most pertinent regarding our dataset and research objectives, we referred to the Akaike information criteria (AIC) and Schwarz's Bayesian information criteria (BIC).

Finally, eleven explanatory variables (detailed hereafter) were selected. We included sociodemographic variables related to age (grouped into four age classes, with four modalities) [*18-34; 35-49; 50-64; over 65 years old*], gender (with two modalities) [*female, male*], department of residence [*coastal department*] and the presence of children in the household [*children*].

Since price is an important factor of FAPs consumption (Claret *et al.*, 2012; Menozzi *et al.*, 2023), and the

price premium associated with labelled products is often perceived as a barrier to their consumption (Roheim *et al.*, 2011), we incorporated a variable related to consumers' price importance when buying FAPs [*price*]. Our consumers were asked to answer the question: "*Would you say that price is your first choice criterion when buying fish at home?*" by positioning themselves on a Likert scale from 0 (Totally disagree) to 10 (Totally agree).

As consumers' motivations are a significant predictor of behaviour regarding ethical consumption (Brécard *et al.*, 2012; Reinstein et Song, 2012; Zander et Feucht, 2018), we integrated three motivation variables into our model. These variables were constructed by factorisation. The first factorial analysis was performed on Schwartz's values-related questions (Schwartz, 1992; Schwartz, 2012) and identified two motivational variables: [*Universalism*] and [*Tradition*]. A series of eight questions (see Table 2.3) were presented to consumers, who were then asked to indicate their level of agreement with each statement on a Likert scale from 0 (Not at all like me) to 7 (Totally like me). Two factors have been retained (Table 2.3). The first factor encompasses three statements (*Take care of nature; Combat threats against nature; Protect the environment*) and measures individuals' degree of universalism, as defined by Schwartz (1992), hereafter referred to as "*Universalism*". The second factor stems from the same factorisation and groups three other statements (*Uphold beliefs in traditional values, Follow traditions, Value traditional practices*). It reflects the attachment to the "*Tradition*" motivation defined by Schwartz (1992). We performed a second factorial analysis on consumer preferences concerning FAPs attributes (Table 2.3), which allowed us to identify one other motivation variable *[Origin]*. The factor identifies consumers' interest in the geographical origin of the product they consume. It encompasses three preferences linked to the origin of FAPs (*fish of local origin; fish of France origin; fish of EU origin*). We identify it as "*Origin*" motivation in our model.

Our model also includes a variable related to consumers' assessment of the ability of individual consumers to influence environmental issues, measured by Perceived Consumer Effectiveness (PCE). Indeed, according to Verbeke *et al.* (2007), the PCE influences consumers' choices regarding green consumption. We performed a third factorial analysis on questions related to consumers' perception of the consequences of their consumption choices on the marine environment. Consumers had to position themselves regarding five statements (see Table 3.4) on a Likert scale from 0 (I totally disagree) to 7 (I totally agree). We named the factor identified as [*PCE*]. Table 2.4 presents the factorisation results.

Finally, subjective [*Subj. Knowl*] and objective [*Obj. Knowl*] knowledge variables were considered. As Pieniak *et al.* (2013), Almeida *et al.* (2015), and Menozzi *et al.* (2023) discussed, consumer knowledge is an essential factor in consumer decision-making, notably regarding FAPs. Our subjective knowledge variable is constructed on an average score obtained regarding four statements, following Zander and Feucht's (2018) article. Consumers were asked to position themselves on a Likert scale from 0 (Totally disagree) to 7 (Totally agree). Our objective knowledge variable is based on the number of correct answers obtained from four "Yes/No" statements. All these statements are detailed in Table 2.A1.

Table 2.A2 summarises all the variables included in our model with their mean values.

**Table 2.3 - Factoring method and associated test results**

| Question used | Most significant variables | Constructed variables | Cronbac's alpha statistic | Barlett test | KMO |
|---|---|---|---|---|---|
| **Factor analysis** #1 | | | | | |
| "I kike ..." | | | | | |
| (1) to take care of nature | | | | | |
| (2) to fight against threats to nature | +(1) (2) (3) | *Universalism* | 0.89 | | |
| (3) to protect the environment | | | | | |
| (4) to help people I care about | | | | p-value = 0.00 | 0.82 |
| (5) to take care of people close to me | | | | | |
| (6) to maintain traditional beliefs and values | +(6) (7) (8) | *Tradition* | 0.85 | | |
| (7) to follow traditions | | | | | |
| (8) to value traditional practices | | | | | |
| **Factor analysis** #2 | | | | | |
| "I prefer ..." | | | | | |
| (1) fresh fish | | | | | |
| (2) wild fish | | | | | |
| (3) local fish | | | | | |
| (4) environmentally friendly production | +(3) (5) (8) | *Origin* | 0.83 | p-value = 0.00 | 0.88 |
| (5) French fish | | | | | |
| (6) raised fish | | | | | |
| (7) fish that do not present a health risk | | | | | |
| (8) European fish | | | | | |

Source - COPECO/RCN survey - 2021

*Note: To determine the internal consistency of items, we used Cronbach's alpha statistic. A score of 0.7 is an acceptably reliable coefficient, but lower thresholds are sometimes used in the literature (see Nunnaly. C, 1978). Factors with an eigenvalue over one are retained. The Bartlett test is Bartlett's test of sphericity, and KMO is the Kaiser-Meyer-Olkin measure.*

**Table 2.4 - Factoring method and associated test results**

| Question used | Most significant variables | Constructed variables | Cronbac's alpha statistic | Barlett test | KMO |
|---|---|---|---|---|---|
| **Factor analysis** #3 | | | | | |
| (1) By buying sustainable FAPs, I can help limit the environmental impact of fishing and aquaculture<br>(2) Whenever I can, I choose sustainable FAPs | +(1) (2) (5) | *PCE* | 0.65 | p-value = 0.00 | 0.72 |
| (3) I can do nothing more about the depletion of fish stocks | -(3) (4) | | | | |
| (4) My FAPs choices do not influence the sustainability of fisheries | | | | | |
| (5) Labels are an effective information tool for the consumer | | | | | |

Source - COPECO/RCN survey - 2021

*Note: To determine the internal consistency of items, we used Cronbach's alpha statistic. A score of 0.7 is an acceptably reliable coefficient, but lower thresholds are sometimes used in the literature (see Nunnaly. C, 1978). Factors with an eigenvalue over one are retained. The Bartlett test is Bartlett's test of sphericity, and KMO is the Kaiser-Meyer-Olkin measure.*

## 2.3 - Results

### 2.3.1 - The most valued labels on the French market

Figure 2.1 gives the first picture of the relative importance of French consumers' preferences regarding labelled FAPs in a trade-off situation. Before interpreting this chart, we performed the F-test and T-test. These tests revealed no statistical difference between the preferences expressed for the quality labels and the "France Origin" labels. In addition, they revealed no statistical difference between the preferences expressed for the ecolabels, the safety claims and the "Local Origin" labels. Otherwise, all the other preferences were statistically differentiated. Table 2.A3 summarises the results of all the tests performed.

According to these results, the two most valued labels are the quality labels, with 17.80 % of the sample ranking it, and the "France Origin" labels, with 17.17 % of the stated preferences. Then comes a group composed of three labels: the ecolabels (11.35 %), the safety allegations (11.14 %), and the "Local Origin" labels (10.72 %), followed by the animal welfare schemes (9.39 %). Finally, three schemes are statistically less preferred by consumers: the Fair-Trade labels, the "Nutrition" claims, and the "EU origin" labels ranked by 6.38 %, 5.26 % and 2.52 % of consumers. Interestingly, 8.27 % of our consumers prefer FAPs without labels. Thus, in a multiple-choice situation, French consumers' preferences for labelled FAPs products are highly heterogeneous. However, this heterogeneity is not uniformly distributed, and some initiatives remain more valued by consumers.

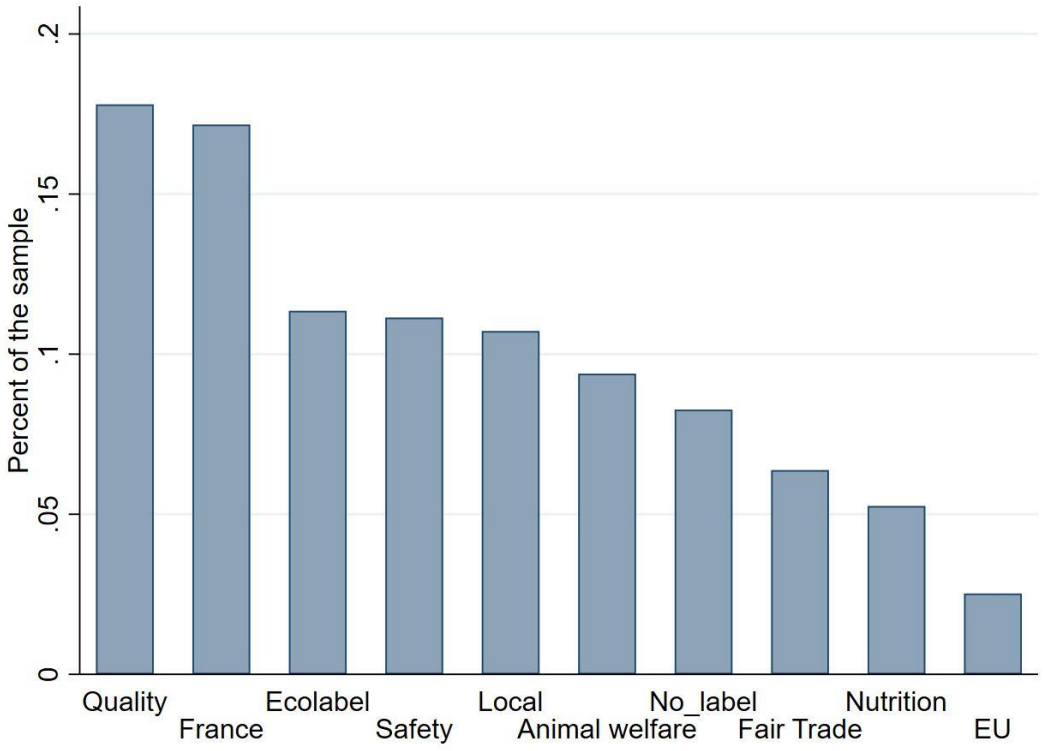


**Figure 2.1 - Expressed preferences of French consumers according to the ten alternatives tested**
Source - COPECO/RCN survey - 2021

### 2.3.2 - The results of the MMNL

Our Mixed Multinomial Logit Model was estimated using STATA.17. Our base outcome is the "No label" alternative. The coefficients presented in the remainder of the article are the marginal effects. They allow a more accurate interpretation of the results compared to the standard coefficient by providing information about the change in predicted probabilities due to a change in a particular predictor (Wulff, 2015). The results of the MMNL are displayed in two separate tables (Tables 2.5 and 2.A4), although all the preferences were conjointly estimated in our model.

Table 2.5 discusses results for six preferences: "France origin", "Local origin", Ecolabel, Animal Welfare, safety allegation and the "No Label" alternative. As French consumers do not highly value them (Figure 2.1), the results for nutrition claims, "EU origin", and Fair-Trade labels will not be discussed but are presented in Table 2.A4. As the notion of quality is highly heterogeneous and each consumer may have his or her own perception of quality, we chose not to discuss the preferences for the quality label. Indeed, interpreting this preference remains highly complex without a better understanding of these different quality expectations. Moreover, consumers can use this label as a "safe-haven" option. Results for this label are also presented in Table 2.A4.

#### 2.3.2.1 - Motivations as drivers of preferences

Table 2.5 highlights the strong link between consumers' motivations and stated preferences. Universalism influences the preferences expressed for different schemes. Individuals with a high degree of universalism tend to prefer ecolabels and animal welfare labels. However, marginal effects show that universalism is more strongly associated with ecolabels preferences (+6.5 %) than animal welfare (+2.7 %). Conversely, the opposite correlation is observed for the "France origin" scheme (-3.2%) and the "No label" alternative (-1.8 %). According to our results, attachment to traditional values also drives consumers' preferences. The positive correlation between "tradition" motivation and the "France origin" label (+3.2 %) seems consistent with the underlying idea of cultural attachment. Nevertheless, finding a negative effect with the "Local origin" label (-1.9 %) is quite surprising. The results show a stronger negative correlation with stated ecolabel preferences (-2.7 %). Finally, and logically, the "origin" motivation increases the probability of choosing "France origin" (+8.6 %) and "Local origin" labels (+5.4 %). On the contrary, this motivation reduces the preferences expressed for ecolabels (-3.1 %) and the "No label" alternatives (-2.1 %).

**Table 2.5 - Mixed multinomial logit model marginal effects**

| | France[a] | Ecolabel[a] | Safety[a] | Local[a] | Animal Welfare[a] | No Label |
|---|---|---|---|---|---|---|
| Nb. Indiv. (%) | 245 (17.17) | 162 (11.35) | 159 (11.14) | 153 (10.72) | 134 (9.39) | 118 (8.27) |
| **Age (Ref [18–34] years old)** | | | | | | |
| [35–49] | .012 (.028) | -.052* (.030) | .057* (.021) | -.011 (.022) | .008 (.025) | .020 (.019) |
| [50-64] | .016 (.028) | -.092*** (.027) | .077*** (.022) | .023 (.024) | -.013 (.023) | .004 (.017) |
| [65+] | .061* (.032) | -.114*** (.027) | .081*** (.026) | .026 (.026) | -.041* (.022) | .012 (.020) |
| **Female** | -.006 (.021) | -.020 (.018) | .050*** (.018) | .001 (.017) | .039** (.016) | -.021 (.014) |
| **Coastal Department** | -.055*** (.021) | -.046*** (.018) | -.002 (.017) | .069*** (.016) | -.002 (.016) | .016 (.013) |
| **Children** | .004 (.023) | -.026 (.018) | .029* (.019) | .008 (.019) | -.026 (.017) | -.033** (.015) |
| **Price** | -.007 (.004) | .001 (.003) | -.001 (.003) | .002 (.003) | -.003 (.003) | .007** (.003) |
| **Motivations** | | | | | | |
| Universalism | -.032** (.014) | .065*** (.012) | .007 (.011) | -.012 (.011) | .027** (.011) | -.018** (.008) |
| Tradition | .032** (.013) | -.027*** (.009) | -.002 (.010) | -.019* (.010) | -.001 (.009) | -.011 (.008) |
| Origin | .086*** (.016) | -.031*** (.010) | -.009 (.012) | .054*** (.013) | -.011 (.010) | -.021*** (.008) |
| **PCE** | -.009 (.015) | .033*** (.012) | .021 (.013) | -.013 (.012) | -.004 (.011) | -.077*** (.009) |
| **Subj. Knowl** | -.008 (.009) | .003(.007) | -.016** (.008) | .008 (.008) | -.009 (.007) | -.003 (.006) |
| **Obj. Knowl** | .012(.009) | -.010 (.007) | .003 (.007) | .008 (.007) | .004 (.007) | -.022*** (.006) |

Source: COPECO/RCN survey - 2021

*Note: [a] Base alternative: No Label*

*Significance threshold: *** 0.01; ** 0.05; *0.1. In parentheses: Standard deviation*

2.3.2.2 - Influence of socio-demographic variables

Behind motivations, socio-demographic characteristics also influence stated preferences in our model. We first find an age effect. We note, for example, that compared to 18 to 34-year-olds, other individuals in our sample are less likely to prefer ecolabels. We also see *via* our marginal effects that the older the consumers get, the more the preferences for these labels decrease. Indeed, compared to 18-34-year-olds, the probability for consumers between 35 and 49 years old to choose ecolabel decreased by 5.2%, while this probability decreased by -11.4 % for those over 65. The opposite outcome is apparent for safety allegations. The older consumers get, the more likely they are to prefer these alternatives. By comparison, the probability of choosing this label increased by 8.1 % for individuals over 65 and by 5.7 % for people between 35 and 49 years old. The change in probability for people between 50 and 64 years old is 7.7 %. Finally, if we look specifically at consumers over 65, they express a specific interest in the ”France origin” labels (+6.1 %) and are less interested in the animal welfare ones (-4.1 %).

A gender effect also appears in Table 2.5. Women seem to value safety allegations and animal welfare labels more than men. This effect is more pronounced for safety claims, with a marginal effect of 5 %, higher than for animal welfare schemes (+3.9 %). Interestingly, the presence of children in the household influences only the preferences for the “safety claim” (+2.9 %) and the “No label” option (-3.3 %). Our results also reveal a coastal effect. Indeed, living close to the coast positively influences the preference for a “Local origin” label (+6.9 %). Conversely, it reduces preferences for ecolabels and “France origin” labels. This effect is more significant for the “France origin” label (-5.5 %) than for the ecolabel (- 4.6 %).

Finally, variables linked to consumers’ knowledge and PCE marginally influence the stated preferences. Indeed, objective knowledge influences only the expressed preferences for the “No label” alternative (-2.2 %). Although we find an effect of subjective knowledge on preferences regarding safety claims (-1.6 %), no other relationship is highlighted in our results. The PCE variable influences only the preferences for ecolabels (+3.3 %) and the “No label” (-7.7 %). Attention paid to price during FAPs purchasing acts influences only the preferences for the “No label” alternative (+0.7 %).

## 2.4 - Discussion

As outlined above, labels are highly developed in the French FAPs sector. However, until now, we had limited information on how consumers' preferences for these schemes were structured. In limited-choice studies, each label under consideration seems to be essential without considering the possible interactions with other initiatives. Indeed, although the literature on consumer preferences is abundant (Wessells *et al.*, 1999; Jaffry *et al.*, 2004; Pieniak *et al.*, 2010; Claret *et al.*, 2012; Brécard *et al.*, 2012; Uchida *et al.*, 2014; Weitzman and Bailey, 2018; Zander and Feucht, 2018; Zander *et al.*, 2022), it was difficult to estimate the relative place of specific preference in the global demand. However, as Lucas *et al.* (2019) discussed, “*it is essential to study consumer preferences in a multiple-label framework to determine realistic preferences*”. Our multiple-choice approach fills this gap. It

better captures the trade-offs encountered during consumer purchasing acts and better reveals relative preferences. It allows the identification of the labels most valued within the market and those that are least researched. We even have information on the share of consumers not interested in labelled FAPs. Finally, this approach makes comparing the different consumption profiles corresponding to the expressed preferences easier. These profiles are essential for policymakers and industry to adapt their labelling strategies. More generally, this approach provides genuine contributions compared to constrained choice approaches, *ceteris paribus*. This conclusion is in line with Fok *et al.* (2012), Nguyen *et al.* (2015) and Wulff (2015) on the contribution of multiple-choice methods.

Our results underline the substantial heterogeneity of French consumer preferences relating to FAPs labelling issues. This heterogeneity was expected with respect to existing works (Johnston *et al.*, 2001; Teratanavat and Hooker, 2006; Hasselbach and Roosen, 2015; Bronnmann *et al.*, 2021). Nevertheless, it is now possible to identify how this heterogeneity is structured. As in other food markets, Figure 2.1 confirms the relative importance of domestic production for French FAP consumers, where 17.17 % preferred the "France origin" label, and 11.72 % the "Local origin" label. These results are consistent with the existing literature (Uchida *et al.*, 2014; Feldmann and Hamm, 2015; Banovic *et al.*, 2019). Conversely, the "EU origin" label is often overlooked when consumers have the opportunity to select "domestic" alternatives. This result underlines the preference for the closest productions, as demonstrated by Uchida *et al.* (2014) and Picha *et al.* (2017), when consumers have the choice. However, this result could have been modified with a different geographical scope (for example, "EU origin" *versus* "Worldwide origin"). Regarding the policy side, promoting French FAPs represents a promising lever with various advantages. First, promoting national FAPs ensures economic support for the national value chain in response to this weakened sector (Brexit, the energy crisis, closure of fishing areas, etc). Second, it also addresses food sovereignty issues, a debate that has been back on the agenda since the COVID crisis. Third, promoting domestic production is relevant from an environmental perspective. On the one hand, consumers are provided with resources managed under the Common Fisheries Policy[26] (CFP). On the other hand, it can reduce fishing pressure on certain exploited stocks and minimise emissions caused by transporting these imported species.

Several works have discussed growing ethical demand in the food sector (Grunert *et al.*, 2014; Bratanova *et al.*, 2015; Tomsa *et al.*, 2021). However, Sonntag *et al.* (2023) show that consumers' egoistic interests are stronger than altruistic ones in a trade-off situation. Our results tend to confirm this finding. Indeed, in a multiple-choice situation, quality and "France origin" labels are significantly preferred to ethical labels (ecolabel, animal welfare, fair-trade). We also find that safety allegations are significantly more researched than animal welfare and Fair-Trade labels. In summary, our results show that ethical preferences remain secondary compared to "self-oriented" ones (related to Quality, France origin labels or safety allegations) when it comes to labelled FAPs consumption.

The third position of ecolabels in the stated preferences leads to discussion. Indeed, when we consider the

[26] The Common Fisheries Policy is a European sector-specific policy. Formulated in 1983, one of its main functions is the preservation of exploited stocks.

numerous literature that focuses solely on ecolabels (Wessells *et al.*, 1999; Jaffry *et al.*, 2004; Brécard *et al.*, 2009; Brécard *et al.*, 2012; Salladarré *et al.*, 2010; Lucas *et al.*, 2018; Banovic *et al.*, 2019; Lucas *et al.*, 2021), we tend to overestimate the importance of this demand in the FAPs sector. However, as discussed, consumers prefer other labels such as quality or "France origin". Ecolabels are, however, part of national and European strategies for resource conservation. Fostering this green demand is essential to achieve this objective. In this line, several levers are discussed in the literature. According to Giacomarra *et al.* (2021), consumer information on ecolabels is essential, particularly in this global context of mistrust. In our survey, 40% of individuals still doubt that buying sustainable FAPs can help to protect the ocean[27].This perception is even more pronounced among older generations. Considering the influence of behavioural insights for reinforcing "*existing instruments and help achieve policy objectives*" could be relevant (Grolleau *et al.*, 2016). These behavioural-based instruments can address some of the limitations of approaches based on the market.

These suggestions for policy improvement are all the more important to consider as our results suggest that green demand could grow in the future. Indeed, our model highlights that the young generation particularly values ecolabels. Moreover, this generation is deeply committed to the responsible consumption trend (Ivanova *et al.*, 2019). We can thus assume that green demand will increase in the coming years, confirming an ongoing trend in the FAPs market (Lucas *et al.*, 2021; European Commission 2016, 2018, 2021). The same assumption can also be made regarding the animal welfare label. Currently, this scheme is valued by 9.39 % of individuals in our sample, ranking it the fifth most popular label. However, our results show that older consumers are less interested in this label. More generally, these two results support the idea of a growing "ethical demand", consistent with the Zander and Feucht (2018) and Maesano *et al.* (2020) findings.

Nevertheless, these results should be considered carefully as we work on stated preferences. Indeed, there is often a behavioural gap (Young *et al.*, 2010) between expressed preferences and real purchasing acts. Firstly, regarding preferences for domestic production. As discussed before, French FAPs consumption greatly depends on importation. For an annual consumption of 33.5 kg FAPs per person, six species (tuna, salmon, cod, mussels, Alaska pollock and shrimps) represent 47% of consumption, and these species are mostly imported (FranceAgriMer, 2021a). Recent consumption even tends to show an increase in the consumption of imported salmon and shrimp (Heutte *et al.*, 2023). Although French consumers declare preferences for domestic FAPs, their daily consumption shows a very different reality. Consuming French products, therefore, implies a profound change in their eating habits. However, this change seems challenging, especially over the short term. Long-term policies must be implemented to initiate structural changes, notably by educating young consumers. Secondly, this behavioural gap may also challenge the apparent growing ethical demand. This phenomenon is particularly well-known regarding sustainable goods (Padel and Foster, 2005; Lombardot et Mugel, 2017). Indeed, when discussing sustainable consumption, consumers often declare that they pay attention to it (to conform to "societal

[27] We asked consumers to position themselves on a 0 to 7 scale regarding the question: "*By buying sustainable seafood, I can help limit the environmental impact of fishing and aquaculture*".

expectations"). Nevertheless, real purchasing behaviours are often not consistent with this positioning. Again, there are several ways to limit this behavioural gap, including informing and educating consumers.

For the first time, we obtained direct information on consumers who do not value labelled FAPs. These profiles are often poorly studied in the literature. As expected, price can be a barrier to preferences for labelling schemes. We show that price-conscious consumers tend to prefer unlabelled FAPs. As labels are associated with a price premium (Roheim *et al.*, 2011), these consumers tend to prioritise unlabelled FAPs. On the contrary, we find that households with children are less interested in unlabelled FAPs. One possible explanation is that labels are often associated with products of higher quality. Parents will tend to prioritise differentiated products to ensure their children's well-being. Unsurprisingly, we also find that consumers' knowledge influences the rejection of unlabelled FAPs. Our results show that people who are aware of the sector (and related issues) and who believe that their consumption choices can influence the environment's future reduce their preferences for non-labelled products. This aligns with the literature, often revealing that consumer involvement drives expressed preferences for labels (Olsen, 2003; Pieniak *et al.*, 2010; Zander *et al.*, 2022). Finally, the "*Universalism*" and "*Origin*" motivations also reduce the expressed preferences for unlabelled FAPs. As existing literature shows that motivations are essential drivers of consumer preferences for labelled products, it is not surprising that consumers who express one of these two motivations tend to have a lower preference for non-labelled FAPs.

According to FranceStratégie (2021), French food policies fail to encourage FAPs consumption, despite their recognised health benefits. One explanation is that these policies tend to be rigid and poorly adaptive. A tailored communication that better accounts for the heterogeneity of consumption profiles could be critical to making them more efficient. Our article provides interesting insights on this point. Age is, for instance, a factor to consider in policy implementation. To encourage young people to eat FAPs guarantees related to the environmental attributes of FAPs can be promising. On the contrary, older people are more interested in the health aspect of FAPs, as they are more directly involved in these issues (Pieniak *et al.*, 2010; Carlucci *et al.*, 2015). Our model also highlights that coastal households have differentiated expectations compared to non-coastal ones. Indeed, they are particularly looking for locally labelled FAPs. According to the existing literature (Feldmann and Hamm, 2015; Picha *et al.*, 2017; Zander *et al.*, 2022), local food is associated with a high-quality product, a product with low environmental impacts or a product that supports the local economy. Coastal consumers, therefore, use the "Local origin" labels as a proxy for these product attributes. This perceived premium quality of local products may also explain the rejection of products labelled "France origin" in these areas. Indeed, the closer the production is to the consumer, the higher the perceived quality (Pıcha *et al.*, 2017). Conversely, living in a coastal area reduces preferences for ecolabels. According to Salladarré *et al.* (2010), ecolabels can be perceived as a barrier to local fisheries and activities endemic to the territory. Globally, place of residence may also be a relevant characteristic for implementing efficient policies. Other variables, such as gender or the presence of children in the household, can also be interesting to consider in policy implementation according to our model.

This work has certain limitations. First, preferences are studied "all things being equal", and characteristics

such as the price of a product, its mode of presentation, its species, the certifying organisation, the level of transparency, and the formulation and control of standards defined are not considered. However, these factors are essential in choosing labelled FAPs (Wessells *et al.*, 1999; Jaffry *et al.*, 2004; Brunsø *et al.*, 2009; Menozzi *et al.*, 2020; Bronnmann *et al.*, 2021). Second, the well-documented gap between data on declared behaviours and real purchases (Ankamah-Yeboah *et al.*, 2020) also requires treating the results of this survey with caution when focusing on the real purchasing behaviour of households. Finally, this work focuses on the French market only. Therefore, our results must be generalised to other consumption markets to compare our results and provide more general recommendations.

## 2.5 - Conclusion

Labels are developing and diversifying in the FAPs sector. They are used to guide consumers toward more sustainable choices. Consequently, understanding how consumer preferences are structured regarding these different schemes has become essential, particularly in the context of the FAPs production system transition. By quantifying the demand for labelled FAPs on the French market and studying preferences for them in a multiple choices situation, this article identified paths of reflection that can help public decision-makers to orient their future choices regarding public policies.

First, our results identified substantial heterogeneity regarding the preferences expressed. French consumers highly valued quality and "France origin" schemes. In a global manner, French consumers remain highly "self-oriented" in their preferences. Nevertheless, although secondary, ethical demand (ecolabel and animal welfare) could become dominant in the years to come, supported by the expectations of the young generation. To support this growing demand and reach global objectives of sustainable consumption, policymakers need to inform consumers and adapt their existing policies approach.

Despite diverse expectations, existing policies are often rigid and fail to reach their objectives. Our results provide interesting insights regarding consumption profiles between stated preferences. They show the strong influence of motivations in the preference expressed regarding labelled FAPs. It seems that consumers' degree of universalism and interest in the origin of FAPs are significant drivers of preferences. Moreover, socio-demographic variables such as age, gender, and even living area influence the choices expressed. To implement more adaptive and effective policies, better considering this diversity of consumption profiles is critical. The introduction of systematic surveys regarding FAPs consumption expectations could be an interesting tool to implement. As food markets are changing quickly (and so are consumer expectations), monitoring these expectations more regularly could enable policymakers to anticipate changes in demand more accurately.

Applying this approach to multi-labelled FAPs could be a relevant extension to this study. In the context of strong market competition and heterogeneous consumer preferences, the food sector increasingly uses the "multi-labellisation" process. However, we still have limited knowledge of how consumers perceive and value these new products, especially in the FAPs sector. New insights on this issue, such as the most valued label combinations, the role played by motivations interactions, etc., could pave the way towards greater sustainability.

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## 2.6 - Appendix

**Table 2.A1 - Questions used to build the objective and subjective knowledge variables**

| Questions | Answers |
|---|---|
| **Subjective knowledge** | |
| Compared to the average person, I know a lot about fish | Likert scale from 0 (I totally disagree) to 7 (I totally agree) |
| I don't know much about how to assess the quality of fish* | |
| People who know me regard me as an expert on fish. | |
| I don't know much about preparing fish* | |
| **Objective knowledge** | |
| Farmed products and aquaculture products mean the same thing | TRUE |
| The production method (wild or farmed) is not compulsory information on seafood sold fresh in the French market | FALSE |
| Oils and meal from wild fish are used as feed for farmed fish | TRUE |
| The majority of FAPs marketed in France are landed by small coastal vessels | FALSE |

Source - COPECO/RCN survey - 2021

*Note:* The results of these questions have been reversed for the analysis.*

**Table 2.A2 - Detailed of the eleven variables included in the MMNL**

| Variables | Modality | Signification | Variable construction | Mean |
|---|---|---|---|---|
| Age (Class reference ([18-34]) | *[18-34]* | The individual is between 18 and 34 years old | Coded 1 if [18-34] | 0.24 |
| | *[35-49]* | The individual is between 35 and 49 years old | Coded 1 if [35-49] | 0.25 |
| | *[50-64]* | The individual is between 50 and 64 years old | Coded 1 if [50-64] | 0.26 |
| | *[65+]* | The individual is over 65 years old | Coded 1 if [65+] | 0.25 |
| Gender | *Female* | The individual is a female | Coded 1 if female, 0 if man | 0.51 |
| | *Male* | The individual is a male | Coded 1 if male, 0 if female | 0.49 |
| Children | *Children* | There is at least one child under 18 in the household | Coded 1 if children are present | 0.44 |
| Coastal department | *Coastal Department* | The individual lives in a coastal department | Coded 1 for people living in a coastal department | 0.36 |
| Price | *Price* | The consumer considers that price is her/his primary purchasing criterion when buying FAPs | Likert scale from 0 to 10 | 5.91 |
| Universalism | *Universalism* | The individual shows a high degree of universalism | Factorisation of Schwartz value questions. Likert scale from 0 to 6 | -9.65e-11 |
| Tradition | *Tradition* | The individual is attached to traditional values | Factorisation of Schwartz value questions. Likert scale from 0 to 6 | - 2.52e-09 |
| Origin | *Origin* | The individual express interest in the origin of FAPs | Factorisation of consumers' preference questions. Likert scale from 0 to 6 | -4.03e-10 |
| Perceived consumer effectiveness | *PCE* | Individual's estimate of his or her ability to contribute to specific sustainable development-related outcomes through specific behaviours. | Factorisation of questions on consumer perceptions | -1.19e09 |
| Subjective knowledge | *Subj. Know* | The individual considers himself/herself as an expert of the sector | Average score on multiples questions Likert scale from 0 to 7 | 3.28 |
| Objective knowledge | *Obj. Know* | The individual is an expert of the sector | Average score on multiples questions | 1.66 |

Source - COPECO/RCN survey - 2021

**Table 2.A3 - Detailed results of the t-tests**

| **Labels 1** | Quality | France origin | Ecolabel | Safety allegation | Local origin | Animal Welfare | No Label | Fair-Trade | Nutrition | EU origin |
|---|---|---|---|---|---|---|---|---|---|---|
| **Label 2** | | | | | | | | | | |
| Quality | X | **H0** | . | . | . | . | . | . | . | . |
| France origin | **H0** | X | . | . | . | . | . | . | . | . |
| Ecolabel | . | . | X | **H0** | **H0** | . | . | . | . | . |
| Safety allegation | . | . | **H0** | X | **H0** | . | . | . | . | . |
| Local origin | . | . | **H0** | **H0** | X | . | . | . | . | . |
| Animal Welfare | . | . | . | . | . | X | . | . | . | . |
| No Label | . | . | . | . | . | . | X | . | . | . |
| Fair-Trade | . | . | . | . | . | . | . | X | . | . |
| Nutrition | . | . | . | . | . | . | . | . | X | |
| EU origin | . | . | . | . | . | . | . | . | . | X |

Source - COPECO/RCN survey - 2021

*Note: Null Hypothesis (H0): means are equal. Alternative hypothesis (.): means are statistically different*

**Table 2.A4 - Mixed multinomial logit model marginal effects (2)**

| | Quality[a] | Fair-Trade[a] | Nutrition[a] | EU[a] |
|---|---|---|---|---|
| Nb. Indiv. (%) | 254 (17.80) | 91 (6.36) | 75 (5.26) | 36 (2.52) |
| **Age (Ref [18-34])** | | | | |
| [35-49] | -.014 (.029) | .010 (0.21) | -.022 (.015) | -.008 (.015) |
| [50-64] | -0.15 (.030) | .012 (.020) | .011 (.019) | -.025* (.013) |
| [65+] | .001 (.020) | -.008 (.019) | .001 (.020) | -.018 (.015) |
| **Female** | -.026 (.022) | -.021 (.014) | .008 (.013) | -.004 (.009) |
| **Coastal Department** | .024 (.020) | -.004 (.013) | .008 (.012) | -.007 (.009) |
| **Children** | .043* (.023) | -.017 (.015) | .013 (.013) | .005 (.009) |
| **Price** | -.001 (.004) | -.003 (.003) | .001 (.003) | .003* (.002) |
| **Motivations** | | | | |
| Universalism | -.040*** (.013) | .001 (.009) | -.002 (.007) | .006 (.009) |
| Tradition | .013 (.013) | .007 (.008) | .006 (.007) | .003 (.005) |
| Origin | -.030** (.014) | -.012 (.009) | -.029*** (.007) | .002 (.006) |
| **PCE** | -.003 (.015) | .036 ***(.011) | .009 (.008) | .008 (.007) |
| **Subj. Knowl** | .028*** (.010) | -.003 (.006) | -.001 (.006) | .004 (.004) |
| **Obj. Knowl** | .002 (.009) | -.002 (.006) | .003 (.005) | .002 (.004) |

Source - COPECO/RCN survey - 2021

*Note: [a] Base alternative: No Label*

*Significance threshold: *** 0.01; ** 0.05; *0.1. In parentheses : Standard deviation*

## 2.7 - References

**Ahern, M., Thilsted, S. H., & Oenema, S**. (2021). The Role of Aquatic Food in Sustainable Healthy Diets - EAT. *Technical Report May*, United Nations. from https://eatforum.org/learn-and-discover/aquatic-food-sustainable-healthy-diets/

**Almeida, C., Altintzoglou, T., & Cabral, H.** (2015). Does seafood knowledge relate to more sustainable consumption ? *British Food Journal*, 117(2):894–914. https://doi.org/10.1108/BFJ-04-2014-0156

**Ankamah-Yeboah, I., Asche, F., Bronnmann, J., Nielsen, M., & Nielsen, R**. (2020). Consumer preference heterogeneity and preference segmentation: The case of ecolabeled salmon in Danish retail sales. *Marine Resource Economics*, 35(2):159–176. https://doi.org/10.1086/708508

**Banovic, M., Reinders, M.J., Claret, A., Guerrero, L., & Krystallis, A.** (2019). A cross- cultural perspective on impact of health and nutrition claims, country-of-origin and eco-label on consumer choice of new aquaculture products. *Food Research International*, 123(January):36–47. https://doi.org/10.1016/j.foodres.2019.04.031

**Bhat, C.R., & Gossen, R.** (2004). A mixed multinomial logit model analysis of weekend recreational episode type choice. *Transportation research*, 38:767–787. https://doi.org/10.1016/j.trb.2003.10.003

**Bonnet, C., & Simioni, M.** (2001). Assessing consumer response to Protected Designation of Origin labelling: a mixed multinomial logit approach. *European Review of Agricultural Economics*, 28(4): 433–449. https://doi.org/10.1093/erae/28.4.433

**Bratanova, B., Vauclair, C.M., Kervyn, N., Schumann, S., & Wood, R., & Klein, O.** (2015). Savouring morality. Moral satisfaction renders food of ethical origin subjectively tastier. *Appetite*, 91:137–149. https://doi.org/10.1016/j.appet.2015.04.006

**Brécard, D., Hlaimi, B., Lucas, S., Perraudeau, Y., & Salladarré, F.** (2009). Determinants of demand for green products: An application to eco-label demand for fish in Europe. *Ecological Economics*, 69(1):115–125. https://doi.org/10.1016/j.ecolecon.2009.07.017

**Brécard, D., Lucas, S., Pichot, N., & Salladarré, F.** (2012). Consumer preferences for eco, health and fair trade labels. An application to seafood products in France. *Journal of Agricultural and Food Industrial Organization*, 10(1). https://doi.org/10.1515/1542-0485.1360

**Bronnmann, J., Stoeven, M.T., Quaas, M., & Asche, F.** (2021).Measuring Motivations for Choosing Eco-labeled Seafood: Environmental Concerns and Warm Glow. *Land Economics*, 97(3). http://dx.doi.org/10.3368/wple.97.3.101119-0147R

**Brunin, J., Pointereau, P., Allès, B., Touvier, M., Hercberg, S., Lairon, D., Baudry, J., & Kesse-Guyot, E.** (2022). Are recent dietary changes observed in the NutriNet-Santé participants healthier and more sustainable? *European Journal of Nutrition*, 61 (1):141–155. https://doi.org/10.1007/s00394-021-02631-y

**Brunso, K., Verbeke, W., Olsen, S.O., & Jeppesen, L.F.** (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

**Carlucci, D., Nocella, G., De Devitiis, B., Viscecchia, 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

**Caswell, J.A., & Mojduszka, E.M.** (1996). Using Informational Labeling to Influence the Market for Quality in Food Products. *American Journal of Agricultural Economics*, 78(5):1248–1253. https://doi.org/10.2307/1243501

**Claret, A., Guerrero, L., Aguirre, E., Rincon, L., Hernandez, M.D., Martinez, I., Benito, P.J., Grau, A., & Rodriguez-Rodriguez, C.** (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

**Clark, B., Stewart, G.B., Panzone, Luca, A., Kyriazakis, I., & Frewer, L.J.** (2017). Citizens, consumers and farm animal welfare: A meta-analysis of willingness-to-pay studies. *Food Policy*, 68: 112–127. https://doi.org/10.1016/j.foodpol.2017.01.006

**Crona, B.I, Daw, T.M., Swartz, W., Norstrom, A.V., Nystrom, M., Thyresson, M., Folke, C., Hentati-Sundberg, J., Osterblom, H., Deutsch, L., & Troell, M.** (2016).Masked, diluted and drowned out: how global seafood trade weakens signals from marine ecosystems. *Fish and Fisheries*, 17(4):1175–1182. https://doi.org/10.1111/faf.12109

**Darby, M.R,. & Karni, E.** (1973). Free Competition and the Optimal Amount of Fraud. *The university of Chicago Press Journals*, 16(1):67–88. https://doi.org/10.1086/466756

**European Commission.** (2016). Habitudes de consommation relatives aux produits de la pêche et de l'aquaculture - France. *Technical report*, from https://europa.eu/eurobarometer/surveys/detail/2106

**European Commission.** (2018). Habitudes de consommation à l'égard des produits de la pêche et de l'aquaculture - France. *Technical report*, from https://europa.eu/eurobarometer/surveys/detail/2206

**European Commission.** (2021). Habitudes de consommation à l'égard des produits de la pêche et de l'aquaculture - France. *Technical Report*, from https://europa.eu/eurobarometer/surveys/detail/2271

**Feldmann C., & Hamm U.** (2015). Consumers' perceptions and preferences for local food: A review. *Food Quality and Preference*, 40(PA):152–164. https://doi.org/10.1016/j.foodqual.2014.09.014

**Fok, D., Paap, R., & Van Dijk, B.** (2012). A rank-ordered logit model with unobserved het- erogeneity in ranking capabilities. *Journal of Applied Econometrics*, 27(5):831–846. https://doi.org/10.1002/jae.1223

**Fonner, R., & Sylvia, G.** (2015). Willingness to pay for multiple seafood labels in a niche market. *Marine Resource Economics*, 30(1):51–70. http://dx.doi.org/10.1086/679466

**FranceAgrimer.** (2019). Baromètre d'image des produits aquatiques - Rapport d'étude - Décembre 2019. *Technical report*, FranceAgriMer, from https://www.franceagrimer.fr/fam/content/download/63161/document/Rapport%20FranceAgrimer%20-%20V2%202019%20.pdf?version=3

**FranceAgriMer.** (2021a). Consommation des produits de la pêche et de l'aquaculture 2020. Données et bilans. *Données et bilans de l'Etablissement national des produits de l'agriculture et de la mer*, page 128, from https://www.franceagrimer.fr/fam/content/download/67093/document/STA_MER_CONSO_2020.pdf?version=3

**FranceAgriMer.** (2021b). Chiffres-clés des filières pêche et aquaculture en France en 2021. FranceAgriMer, page 40, from https://www.franceagrimer.fr/fam/content/download/67037/document/CC_p%C3%AAche_aqua%20_FR.PDF?version=6

**FranceStratégie** (2021). Pour une alimentation saine et durable. *Technical report*, from https://www.strategie.gouv.fr/publications/une-alimentation-saine-durable-rapport-lassemblee-nationale

**Giacomarra, M., Crescimanno, M., Vrontis, D., Miret Pastor, L., & Galati, A.** (2021) The ability of fish ecolabels to promote a change in the sustainability awareness. *Marine Policy*, 123. https://doi.org/10.1016/j.marpol.2020.104292

**Gracia A., & De-Magistris, T.** (2016). Consumer preferences for food labeling: What ranks first? *Food Control*, 61:39–46. https://doi.org/10.1016/j.foodcont.2015.09.023

**Grolleau, G., Ibanez, L., Mzoughi, N., & Teisl, M.** (2016). Helping eco-labels to fulfil their promises. *Climate Policy*, *16*(6), 792–802. https://doi.org/10.1080/14693062.2015.1033675

**Grunert, K.G., Hieke, S., & Wills, J.** (2014). Sustainability labels on food products: Consumer motivation, understanding and use. *Food Policy*, 44:177–189. doi: https://doi.org/10.1016/j.foodpol.2013.12.001

**Hasselbach, J.L., & Roosen, J.** (2015). Consumer Heterogeneity in the Willingness to Pay for Local and Organic Food. *Journal of Food Products Marketing*, 21(6):608–625. https://doi.org/10.1080/10454446.2014.885866

**Heutte, K., Daures, F., Lucas, S., Girard, S., Alban, F., & Le Floc'h, P.** (2023). Fisheries and aquaculture products consumption in France: when the Covid-19 crisis did not lead to more sustainable purchases. *Aquatic Living Resources*, *36*(10), 19p. https://doi.org/https://doi.org/10.1051/alr/2023004

**Hicks, D., Pivarnik, L., McDermott, R.** (2008). Consumer perceptions about seafood - an Internet survey. *Journal of Food Service*, 19(4):213–226. http://dx.doi.org/10.1111/j.1748-0159.2008.00107.x

**Ivanova, O., Flores-Zamora, J., Khelladi, I., & Ivanaj, S.** (2019).The generational cohort effect in the context of responsible consumption. *Management Decision*, 57(5):1162–1183. https://doi.org/10.1108/MD-12-2016-0915

**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

**Johnston, R.J., Wessells, C.R., & Asche, F.** (2001). Measuring Consumer Preferences for Eco-labeled Seafood: An International Comparison. *Research in Economics*, 26(42):20–39. http://dx.doi.org/10.22004/ag.econ.31157

**Lancaster, K.J.** (1966). A New Approach to Consumer Theory. *Journal of political economics*, 74(2):106–107. https://doi.org/10.1086/259131

**Lewis S.G., & Boyle M.** (2017). The Expanding Role of Traceability in Seafood: Tools and Key Initiatives. *Journal of Food Science*, 82:A13–A21. https://doi.org/10.1111/1750-3841.13743

**Lombardot, E., & Mugel, O.** (2017). Proposition d'un modèle explicatif de l'écart entre intention et comportement responsable en contexte d'achat alimentaire. *Revue de l'organisation responsable,* 12 (1):17. https://doi.org/10.3917/ror.121.0017

**Lucas, S., Salladarré, F., & Brécard, D.** (2018). Green consumption and peer effects: Does it work for seafood products? *Food Policy*, 76(March):44–55. https://doi.org/10.1016/j.foodpol.2018.02.017

**Lucas, S., Gouin, S., & Lesueur, M.** (2019). Seaweed consumption and label preferences in France. Marine *Resource Economics*, 34(2):143–162. https://doi.org/10.1086/704078

**Lucas, S., Soler, L.Georges., & Revoredo-Giha, C.** (2021). Trend analysis of sustainability claims: The European fisheries and aquaculture markets case. *Food Policy*, 104(July):102141. https://doi.org/10.1016/j.foodpol.2021.102141

**Maesano, G., Carra, G., & Vindigni, G.** (2019). Sustainable dimensions of seafood consumer purchasing behaviour: A review. *Qual. Access Succes*, 20(S2):358–364.

**Maesano, G., Vita, G.D., Chinnici, G., Pappalardo, G., & Amico, M.D.** (2020). The Role of Credence Attributes in Consumer Choices of Sustainable Fish Products: A Review. *Sustainability*, https://doi.org/10.3390/su122310008

**McFadden, D.** (1974). Conditional logit analysis of qualitative choice behaviour. *Frontiers in Econometrics.*

**McFadden, D., & Train, K.** (2000). Mixed MNL models for discrete response. *Journal of Applied Econometrics*, 15(5):447–470. https://doi.org/10.1002/1099-1255(200009/10)15:5%3C447::AID-JAE570%3E3.0.CO;2-1

**Menozzi, D., Nguyen, T.T., Sogari, G., Taskov, D., Lucas, S., Castro-Rial, J.L.S., & Mora, C.** (2020). Consumers' preferences and willingness to pay for fish products with health and environmental labels: Evidence from five European countries. *Nutrients*, 12 (9):1–22. https://doi.org/10.3390/nu12092650

**Menozzi, D., Wongprawmas, R., Sogari, G., Gai, F., Parisi, G., & Mora, C.** (2023). The role of objective and subjective knowledge on the attitude and intention of Italian consumers to purchase farmed and wild fish. *Agricultural and Food Economics*, 11(1):1–25. https://doi.org/10.1186/s40100-023-00288-1.

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

**Nguyen, T.T., Haider, W., Solgaard, H.S., Ravn-Jonsen, L., & Roth, E.** (2015). Consumer willingness to pay for quality attributes of fresh seafood: A labeled latent class model. *Food Quality and Preference*, 41:225–236. https://doi.org/10.1016/j.foodqual.2014.12.007

**Nunnaly, C.** (1978). Psychometric Theory. Mcgraw-Hill College.

**Olsen, S.O.** (2003). Understanding the relationship between age and seafood consumption: The mediating role of attitude, health and involvement and convenience. *Food Quality and Preference*, 14 (3):199–209. https://doi.org/10.1016/S0950-3293(02)00055-1

**Overall, J.E., Atlas, R.S., & Gibson, J.M.** (1995). Tests That are Robust against Variance Heterogeneity in k × Designs with Unequal Cell Frequencies. *Psychological Reports*, 76(3):1011–1017. https://doi.org/10.2466/pr0.1995.76.3.1011.

**Padel, S., Foster, C.** (2005). Exploring the gap between attitudes and behaviour: Understanding why consumers buy or do not buy organic food. *British Food Journal*, 107(8):606–625. https://doi.org/10.1108/00070700510611002

**Picha, K., Navratil, J., & Svec, R.**(2017). Preference to Local Food vs Preference to "National" and Regional Food. *Journal of Food Products Marketing*, 00(00):1–21. https://doi.org/10.1080/10454446.2016.1266549

**Pieniak, Z., Verbeke, W., Olsen, S.O., Hansen, K.B., & Brunso, Karen.** (2010). Health- related attitudes as a basis for segmenting European fish consumers. *Food Policy*, 35(5):448–455. https://doi.org/10.1016/j.foodpol.2010.05.002

**Pieniak, Z., Vanhonacker, F., & Verbeke, W.** (2013). Consumer knowledge and use of information about fish and aquaculture. *Food Policy*, 40:25–30. https://doi.org/10.1016/j.foodpol.2013.01.005

**Reinstein D., & Song, J.** (2012). Efficient Consumer Altruism and Fair Trade Products. *Journal of Economics and Management Strategy*, 21(1):213–241. http://dx.doi.org/10.1111/j.1530-9134.2011.00323.x

**Roe, B., & Sheldon, I.** (2007). Credence good labeling: The efficiency and distributional implications of several policy approaches. *American Journal of Agricultural Economics*, 89(4):1020–1033. http://dx.doi.org/10.1111/j.1467-8276.2007.01024.x

**Roheim, C.A., Asche, F., Santos, J.I.** (2011). The elusive price premium for ecolabelled products: Evidence from seafood in the UK market. *Journal of Agricultural Economics*, 62(3):655– 668. https://doi.org/10.1111/j.1477-9552.2011.00299.x

**Rousseau, S.** (2015). The role of organic and fair trade labels when choosing chocolate. *Food Quality and Preference*, 44(April):92–100. https://doi.org/10.1016/j.foodqual.2015.04.002

**Salladarré, F., Guillotreau, P., Perraudeau, Y., & Monfort, M.C.** (2010). The demand for seafood eco-labels in France. *Journal of Agricultural and Food Industrial Organization*, 8(1). https://doi.org/10.2202/1542-0485.1308

**Santeramo, F.G., Carlucci, D., De Devitiis, B., Seccia, A., Stasi, A., Viscecchia, R., & Nardone, G.** (2018). Emerging trends in European food, diets and food industry. *Food Research International*, 104(November): 39–47. https://doi.org/10.1016/j.foodres.2017.10.039

**Schwartz, S.H.** (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. *Advances in Experimental Social Psychology*, 25(C):1–65. https://doi.org/10.1016/S0065-2601(08)60281-6

**Schwartz, S.H**. (2012). An Overview of the Schwartz Theory of Basic Values. *Psychology and Culture*, 2(1):1–20. https://doi.org/10.9707/2307-0919.1116

**Scientific Technical and Economic Committee for Fisheries (STECF).** (2020). The 2020 annual economic report on the EU fishing fleet. *Technical Report*, from https://data.europa.eu/doi/10.2760/500525

**Sogn-Grundvag, G., Larsen, T.A., & Young, J.A.** (2014). Product Differentiation with Credence Attributes and Private Labels: The Case of Whitefish in UK Supermarkets. *Journal of Agricultural Economics*, 65(2):368–382. https://doi.org/10.1111/1477-9552.12047

**Sonntag Winnie, I., Lemken D., Spiller A., & Schulze M.** (2023). Welcome to the (label) jungle? Analyzing how consumers deal with intra-sustainability label trade-offs on food. *Food Quality and Preference*, 104. https://doi.org/10.1016/j.foodqual.2022.104746

**Teratanavat R., & Hooker N.H.** (2006). Consumer valuations and preference heterogeneity for a novel functional food. *Journal of Food Science*, 71(7). http://dx.doi.org/10.1111/j.1750-3841.2006.00120.x

**Tigchelaar, M., Leape, J., Micheli, F., Allison, E.H., Basurto, X., Bennett, A.,Bush, S.R., Cao, L., Cheung, W..L., Crona, B., DeClerck, F., Fanzo, J., Gelcich, S., Gephart, J.A., Golden, C.D., Halpern, B.S., Hicks, C.C., Jonell, M., Kishore, A., Koehn, J. Z., Little, D.C., Naylor, R.L., Phillips, M.J., Selig, E.R., Short, R.E., Sumaila, U. R., Thilsted, S.H., Troell, M., & Wabnitz, C.C.C.** (2022). The vital roles of blue foods in the global food system. *Global Food Security*, 33(October 2021). https://doi.org/10.1016/j.gfs.2022.100637

**Tomsa, M.M., Romonti-Maniu, A.I, & Scridon, M.A.** (2021). Is sustainable Consumption Translated into Ethical Consumer Behaviour? *Sustainability*, 13(6). https://doi.org/10.3390/su13063466

**Uchida, H., Onozaka, Y., Morita, T., & Managi, S.** (2014). Demand for ecolabeled seafood in the Japanese market: A conjoint analysis of the impact of information and interaction with other labels. *Food Policy*, 44:68–76. https://doi.org/10.1016/j.foodpol.2013.10.002

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

**Washington, S.** (2008). Ecolabels and Marine Capture Fisheries: Current Practice and Emerging Issues. Technical report, FAO, from https://www.fao.org/in-action/globefish/%20publications/details-publication/fr/c/346512/

**Weitzman, J., & Bailey, M.** (2018). Perceptions of aquaculture ecolabels: A multi-stakeholder approach in Nova Scotia, Canada. *Marine Policy*, 87(October 2017):12–22. https://doi.org/10.1016/j.marpol.2017.09.037

**Wessells, C.R., Johnston, R.J., & Donath, H.** (1999). Assessing Consumer Preferences for Ecolabeled Seafood: The Influence of Species, Certifier, and Household Attributes. *American Journal of Agricultural Economics*, 81(5):1084–1089. https://doi.org/10.2307/1244088

**Wulff, J.N.** (2015). Interpreting Results From the Multinomial Logit Model: Demonstrated by Foreign Market Entry. *Organizational Research Methods*, 18(2):300–325. https://doi.org/10.1177/1094428114560024

**Young, W., Hwang, K., McDonald, S., & J.Oates, C.** (2010). Sustainable consumption: green consumer behaviour when purchasing products. *Sustainable Development*, 18 (March 2009): 20–31. https://doi.org/10.1002/sd.394

**Zander, K., & Feucht, Y.** (2018). Consumers' Willingness to Pay for Sustainable Seafood Made in Europe. *Journal of International Food and Agribusiness Marketing*, 30(3):251–275. https://doi.org/10.1080/08974438.2017.1413611

**Zander, K., Daurès, F., Feucht, Y., Malvarosa, L., & Pirrone, C.** (2022). Consumer perspectives on coastal fisheries and product labelling in France and Italy. *Fisheries Research*, 246 (November 2021). https://doi.org/10.1016/j.fishres.2021.106168

# Chapter 3: How do production methods affect consumer WTP for single and double-labelled seafood?

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**Abstract**

Despite a growing number of multi-labelled food products, we have a limited understanding of how consumers value them on fishery and aquaculture products (FAPs). In this article, we explore consumers' WTP for single- and dual-labelled FAPs (with a focus on safety labels and ecolabels) in interaction with different FAP attributes, including the production method (wild or farmed). We use a consumer survey conducted on the French market in April 2023, in which 1,895 French consumers responded to two double-bounded procedures. As expected, the production method influences consumers' WTP. Consumers tend to have a higher WTP for safety labels for farmed species and for ecolabels for wild species. If the EU wants to develop the competitiveness of its aquaculture sector, this perception of aquaculture products as risky needs to be overcome, and less impactful production methods need to be promoted. For wild-caught species, if consumers value ecolabels, better control of their expansion will be essential to enable these labels to pursue resource conservation objectives. Furthermore, we find that the marginal WTP for adding a second label is not always positive. If the FAP is already stamped with a label related to the attribute that consumers value the most, adding a second label leads to a reduced WTP. Consumers do not necessarily value information on multiple attributes. Finally, we discussed how to improve the acceptance of double-labelled products, mainly through education and information and by using trustworthy labels.

**Keywords***:* Consumer preferences, Double-bounded process, Double-labelled, Ecolabels, Safety labels, Willingness to Pay.

**JEL classification:** D12, Q21, Q22

# 3.1 - Introduction

### 3.1.1 - General background

Our food systems are facing multiple challenges (FAO, 2018) that call into question their ability to provide a quality diet for a growing global population. Among other things, they are a major contributor to global warming and environmental degradation (De Bauw *et al.*, 2021). In light of these concerns, there has been a strong political commitment to transform the way food is produced and consumed in order to move towards more sustainable and healthier food systems. This transition is a central aspect of the 2030 Agenda for Sustainable Development, adopted by the United Nations in 2015. The "Farm to Fork Strategy[28]" also illustrates this strong political will at the EU level, with the aim of "*making food systems fair, healthy and environmentally friendly*".

Consumer information is presented as an essential lever to achieve this transition. Their knowledge and information are essential to help them make informed choices about the food they consume. Within this idea, consumers have been provided with an increasing amount of information in recent times (Fonner and Sylvia, 2015), including through labels (Sirieix *et al.*, 2013; Janßen and Langen, 2017). As discussed in the "From Farm to Fork" strategy "*As part of its approach to food information to consumers […] the EU will promote schemes*". These labels aim to transform credence attributes into search attributes and are diverse in the food sector. We can speak of a "plethora" of labels (Janßen and Langen, 2017) or a "jungle" of labels (Sonntag *et al.*, 2023). One of the consequences of this tendency is the trend towards "multi-labelled" food, i.e. a food product that carries several labels at the same time (Dufeu *et al.*, 2014).

Several articles have addressed the issue of multi-labelled products in the food sector (Barreiro-Hurlé *et al.*, 2008; Tagbata and Sirieix, 2010; Janssen and Hamm, 2012; Aschemann-Witzel *et al.*, 2013; Sirieix *et al.*, 2013; Dufeu *et al.*, 2014; Fonner and Sylvia, 2015; Janßen and Langen, 2017; De Bauw *et al.*, 2021; Sonntag *et al.*, 2023), but with no real consensus on their potential impact. Dufeu *et al.* (2014) state that "*the implicit assumption of accumulated or increased benefits from multiple labels is questionable*". In this line, Barreiro-Hurlé *et al.* (2008), Sirieix *et al.* (2013) and Sonntag *et al.* (2023) state that there is a risk of loss of product value if the label combination is not perceived as complementary by consumers. Barreiro-Hurlé *et al.* (2008) show that the combination of a health claim and a nutrition claim on sausages and a nutrition panel and a health claim on yoghurt can reduce consumers' perceived utility. However, the latter combination on sausages increases utility, highlighting that the perceived utility of label combinations may vary depending on the products considered. Similarly, depending on the association between multiple sustainability labels on milk, Janßen and Langen (2017) find some positive and negative interaction effects on consumer utility, depending on consumers' knowledge of the "sustainability" concept. Interestingly, they show that the negative utility of a unique label can be reversed when combined with another label. Aschemann-Witzel *et al.* (2013) are interested in the interaction between organic products and health claims. They find that occasional organic consumers are more receptive to choosing

[28] To obtain information on this EU policy: https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

an organic product with additional health claims, while this is less true for intensive organic consumers. In their article, De Bauw *et al.* (2021) find that a combination of an Eco-Score and a Nutriscore can have a positive effect on the Nutritional Quality Index (NQI) of a food basket but no effect on its Environmental Impact Index (EII). They conclude that when combined, consumers tend to prioritise nutritional information over environmental information. Through focus group discussions, Sirieix *et al.* (2013) found that some consumers prefer the combination of sustainable and origin labels, while others prefer the combination of sustainable and "personal interest" labels. Conversely, some label combinations are also rejected, either when the combination involves an unfamiliar or untrusted label, or when the labels are perceived as contradictory. Tagbata and Sirieix (2010) show that dual-labelled chocolate (Fair Trade and Organic) can increase consumers' Willingness To Pay (WTP) compared to chocolate with only one of these unique labels. However, the WTP for these two labels on the same product is less than the sum of the WTP for these two unique labels, the marginal WTP thus decreases. They also find that some consumers prefer chocolate with a single label to chocolate labelled as organic and Fair-Trade, indicating heterogeneity among consumers regarding this multi-labelling process. Dufeu *et al.* (2014) show that increasing the number of labels on honey from zero to three significantly increases consumers' WTP for this product. Their results suggest that the premium attributed to a combination of labels is lower than the sum of the premiums attributed to each unique label, although marginal WTP does not always decrease. Sonntag *et al.* (2023) are interested in the interaction between different multi-level labels (e.g. Nutri-Score). They find that two labels with a positive score tend to increase consumer utility and WTP compared to a single positive score. Conversely, two labels with a negative score tend to decrease consumer utility compared to a single negative score. When consumers are confronted with a conflicting situation (a positive and a negative score), they find that the WTP for these two labels compensates. They conclude that consumers appear to be able to choose between two conflicting multi-level labels when making consumption decisions. Most of these studies highlight the high heterogeneity of consumer preferences for these multi-labelled products. Furthermore, these articles focus on a specific range of food products and labels. In light of these findings, it is currently difficult to make a general statement about the impact of dual/multi-labelling on food products.

### 3.1.2 - Empirical case and hypothesis

In this article, we are interested in the Fishery and Aquaculture Products (FAPs) sector, a sector directly affected by the "label expansion" trend. Three important drivers can explain this reality. First, consumers' limited knowledge of FAPs leads to an interest in information cues. Second, the presence of credence attributes (such as production method, country of origin, quality process, etc.) in FAPs (Sogn-Grundvag *et al.*, 2014), which consumers highly value. Labels have thus emerged as a promising tool to provide consumers with researched information. Finally, in a highly globalised and competitive market (Crona *et al.*, 2016), producers often use labels to differentiate themselves from competitors.

In this article, we are particularly interested in two specific credence attributes when it comes to FAP consumption: safety and environmentally friendly production. Although these attributes are current drivers of FAP consumption, conciliating them can be difficult. Indeed, a green FAP is not necessarily a healthy one, and

*vice versa*. This is particularly true given the diversity of species available on the market. According to the FAO, more than 2 200 species are currently exploited worldwide (FAO, 2020). To add to the diversity (and complexity), FAPs are sourced from two different production methods: wild capture and aquaculture. Globally, these two production methods account for approximately 50% of the world's supply (FAO, 2022). Behind these two sectors, issues are also differentiated (Bennett *et al.*, 2021). On the environmental side, wild fisheries are well known for their impact on stock levels, by-catch species and seabed degradation. Aquaculture is known for its contribution to eutrophication and genetic risks to wild populations (Gephart *et al.*, 2021). From a health perspective, FAPs are globally associated with healthy products (Govzman *et al.*, 2021). However, the global degradation of the marine environment and the use of drugs and hormones in aquaculture raise concerns about their safety. To reconcile the health and environmental aspects of FAP consumption and to guide consumers towards green and healthy choices, labels offer undeniable opportunities. In this article, we are therefore interested in consumers' preferences and WTP for ecolabels, safety labels and their possible association with the same FAP.

Working on these two specific schemes is highly relevant from a consumer perspective. Firstly, as mentioned above, consumers are deeply interested in these two credence attributes when it comes to FAP consumption. Secondly, because of the existing cross motivations for consuming green products. Indeed, we know that the consumption of green products can be motivated by altruistic motivations, namely contributing to collective well-being (Brécard *et al.*, 2009) and by more self-interested interests, especially health motivation (Grunert, 2011; Aschemann-Witzel *et al.*, 2013; Kushwah *et al.*, 2019; Lang and Rodrigues, 2021). These cross motivations can lead to structural changes in the market if, for example, consumers buy ecolabels mainly due to health motivations. In this case, the development of safety labels may lead to a decrease in the demand for ecolabels. These two labels are also interesting in terms of consumer expectations between wild and aquaculture products. Indeed, according to the findings of Zander and Feucht (2018), consumers tend to associate wild fisheries with environmental issues and aquaculture with health concerns. This is in line with the findings of Verbeke *et al.*, (2007a), who suggest that consumers' motivations for avoiding wild species are primarily environmental, while those for farmed species are primarily health-related. Therefore, by including these two labels, we can see whether the production method influences consumers' WTP.

To the best of our knowledge, no previous work has considered the potential interactions between these two schemes on FAPs. In fact, the large body of literature on consumers' WTP is often limited to the interaction of these unique labels with different FAPs attributes. For example, Salladarré *et al.* (2016) investigate consumers' WTP for ecolabels in relation to three different species: monkfish, lobster and sole. Their results show that consumers are willing to pay a premium of around +10% for this information, with no specific species effect. In contrast, Menozzi *et al.* (2020) find a species and country effect on consumers' WTP for ecolabels and nutrition and health claims. Consumers tend to highly value ecolabels for herring (+€2.93 per kilo) and salmon (+€1.95 per kilo) and health claims for salmon (+€2.65 per kilo). Less consumed species, such as pangasius, received a much lower WTP. Bronnmann *et al.* (2016) also find a positive WTP for ecolabelled frozen salmon of around +4%. Banovic *et al.* (2021) analyse consumers' WTP for country-of-origin labelling, nutrition claims, health

claims and ecolabels in relation to different FAPs presentations in five European countries. Overall, they find a positive WTP of +€1.55 per kilo for "domestic production" labels, +€0.34 per kilo for the "rich in omega-3" claim, +€ 0.20 per kilo for "improved heart function" and +€0.44 per kilo for ecolabels. Other works are also interested in the relationship between labels and the value chain. Asche *et al.* (2015) investigate the interaction between retailers and premiums associated with ecolabels. They find an average positive WTP of +13.1% for ecolabelled salmon, with considerable heterogeneity across retailers. Maesano *et al.* (2020) propose an interesting review of consumers' WTP for different labels on FAPs.

In this work, we differ from the aforementioned articles by focusing on consumers' WTP for double labels in interaction with the attributes of FAPs. To our knowledge, only a few articles have considered this multi-labelling process for FAPs. Uchida *et al.* (2014) find a positive WTP of + 44% for ecolabelled salmon from Japan, and a WTP of + 52% for wild ecolabelled salmon from Japan. Globally, they find a decreasing marginal WTP for additional information. Using a choice experiment approach, Fonner and Sylvia (2015) find no evidence that adding a second label to FAPs that already have a local label reduces preference for that local label. More research is needed on multi-labelled FAPs (Carlucci *et al.*, 2015; Fonner and Sylvia, 2015; Menozzi *et al.*, 2020), and this work attempts to fill this gap. Understanding consumers' perceptions and evaluations of double-labelled FAPs could be a crucial factor in facilitating a successful transition to a more sustainable FAPs sector. In light of this global context, we have attempted to test three different assumptions:

- **H1**: Consumers' WTP depends on their socio-demographic characteristics (age, gender, income, etc.).
- **H2**: The production method influences the WTP. The WTP for ecolabels is higher for wild species. Conversely, the WTP for safety labels is higher for farmed species. This assumption is based on the results of Verbeke *et al.* (2007) and Zander and Feucht (2018).
- **H3**: The WTP for double-labelled FAPs is higher than the WTP for single-labelled FAPs. However, this WTP is not additive, as demonstrated by Tagbata and Sirieix (2010), Dufeu *et al.* (2014)[29] and Uchida *et al.* (2014). The marginal WTP for a second label decreases.

We use the French market as a case study to study these different hypotheses. According to the EUMOFA (EUMOFA, 2022), France is one of the most important FAP consumption markets in the EU. It ranks fourth, with an average consumption of 33 kg per capita in 2021. Interestingly, this consumption is concentrated on a few species (tuna, salmon, cod, etc.) (FranceAgriMer, 2023). Salmon accounts for 32% of expenditure on fresh fish, and cod accounts for 17% of this total (FranceAgrimer, 2022). Menozzi *et al.* (2020) demonstrate that these two species are the most popular among French consumers. The majority of salmon consumed in France is produced by aquaculture, while cod is sourced from wild fisheries. Thus, we decided to focus our work on these two species to assess the potential impact of production methods on stated WTP for ecolabels, safety labels, and double-

[29] This result is verified for the switch from a single-label product to a double-label product. This result is not verified for the switch from double-label to triple-label product.

labelled products. Our work focuses on fresh species.

The remainder of this paper is organised as follows. The next section presents the results of our consumer survey and the methodology employed to elicit our consumers' preferences and WTP. In the third section, we present our results. In the fourth section, we discuss our findings and the potential role of double-labelled FAPs in changing consumer behaviour. Finally, we conclude with our main results and potential avenues for future research.

## 3.2 - Materials and methods

### 3.2.1 - Data

#### 3.2.1.1 - Data collection

The data for our empirical analysis comes from a survey conducted in April 2023 on the French market. This survey was part of the FORESEA 2050[30] research programme and was conducted online by KantarWordPanel. The objective of this survey was to analyse French consumption habits and preferences regarding FAPs, with a particular focus on labelling issues. The study was divided into several distinct blocks of 72 questions; 1) FAP consumption habits, 2) FAP consumption behaviour for fresh products, 3) consumer preferences for FAPs, 4) motivations, knowledge and implication of FAPs consumers, 5) double-bounded process and lastly 6) consumer characteristics. An initial sample of 2,000 people was collected. After initial processing of the data to eliminate incomplete or inconsistent responses, the final sample size was 1,895 consumers.

#### 3.2.1.2 - Explanatory variables

To estimate the influence of consumer characteristics on stated WTP **[H1]**, we were interested in the effect of different variables. First, we examined the importance of price when purchasing FAPs, as the price may be a barrier to both FAP consumption and label preference. As knowledge is an important predictor of consumption behaviour (Menozzi *et al.*, 2023), we included three related variables: subjective, objective and species knowledge (cod and salmon). Subsequently, as Zander and Feucht (2018), we examined the influence of consumers' motivations (universalism and tradition) as defined by Schwartz (2012). Additionally, we were interested in consumers' health involvement, which has been identified as an important predictor of FAP consumption (Pieniak *et al.*, 2008). A Perceived Consumers Effectiveness (PCE) variable was included to measure consumers' confidence in their ability to make a difference, notably through their consumption choices (Kim and Choi, 2005). Finally, we also included socio-demographic variables related to age ([18-34] *(base category)*; [35-50]; [51-64]; [65+]), gender (male (*base category)*; female), residence in a coastal department, the presence of children in the household, income ([- 1 800 €] (*base category)*; [1 800-2 799 €]; [More than 2 800 €].

The importance of price when buying FAPs was assessed by the following question:*" Would you say that price is your first choice criterion when buying fish at home?"* Respondents rated the statement using an 11-point

[30] For more information on this program: https://manchemerdunord.ifremer.fr/en/Unite-Halieutique/Recherche/Projets-en-cours/FORESEA

Likert scale from 0 (strongly disagree) to 10 (strongly agree).

Subjective knowledge was measured according to Pieniak *et al.* (2007) and Zander and Feucht (2018) approaches. We included four statements: (1) *"Compared to the average person, I know much about fish"*; (2) *"I have little knowledge about assessing fish quality"*; (3) *"People who know me consider me to be a fish expert"*; (4) *"I don't know much about fish preparation"*. Respondents rated the statements on an 8-point Likert scale from 0 (strongly disagree) to 7 (strongly agree). To measure consumers' objective knowledge, we proposed a set of eleven statements related to the FAP sector (Table 3A.1). The variable measures the number of correct answers: the more correct answers you get, the higher your score. To measure species-specific knowledge, we asked our consumers, *"In our opinion, what is the origin of the majority of salmon/cod consumed in France?"*. They had to choose between five answers (ranging from "*less than 20 %*" to "*more than 80 %*").

We used the approach of Zander and Feucht (2018) for universalism and tradition motivations. We asked consumers two sets of three questions. The first set was related to consumers' perceptions of their impact on societal well-being: (1) *"He/she firmly believes in taking care of nature"* ; (2) *" It is important for him/her to fight against threats to nature"* ; (3) *"Protecting the environment from destruction or pollution is important to him/her"*. The second set was related to their attachment to tradition and culture: (1) "*It is important for him/her to maintain traditional beliefs and values"* ; (2) "*Following family or religious traditions are important to him/her"* ; (3) "*He/she strongly values the traditional practices of his/her culture"*. Respondents rated the statements on a 7-point Likert scale from 0 "not at all like me" to 6 "totally like me".

In order to measure consumers' health involvement in their food choices, we included three different questions related to consumers' behaviour regarding the health aspects of their food consumption. (1) "*He/she pays attention to his/her food choices for better health*" ; (2) "*It is important for him/her to avoid processed foods that are too rich in salt, sugar, etc*." ; (3) "*He/she pays attention to the risks of contamination present in food*". Respondents rated the statements using a 7-point Likert scale from 0 "not at all like me" to 6 "totally like me".

Finally, we also wanted to measure the PCE of our consumers. We included four questions in our survey: (1) "*By buying sustainable seafood, I can help limit the environmental impact of fishing and aquaculture*" ; (2) "*Whenever I can, I choose sustainable seafood*" ; (3) "*My seafood choices have no impact on the sustainability of fisheries*" ; (4) "*There is nothing I can do about the depletion of natural fish stocks*". Respondents rated the statements on an 8-point Likert scale from 0 "strongly disagree" to 7 "strongly agree".

Factor analysis was then used to determine the internal reliability of consumers' responses to our questions about motivations, health involvement and PCE. Cronbach's alpha and the KMO test showed good internal reliability for these variables, allowing us to perform some factoring. The results of these tests and the variables included are presented in Table 3A.2.

### 3.2.2 - Methods

3.2.2.1 - Double-bounded process

To measure consumers' WTP for labelled FAPs, we decided to use a contingent valuation method called the double-bounded dichotomous choice model (DBCM) (Salladarré *et al.*, 2016). WTP can be understood as the maximum amount an individual is willing to pay for an additional attribute (in our case, an ecolabel, a safety label or both labels), all other things being equal. The DBCM approach is based on two bids.

The initial bid is structured as follows: "*Knowing that the average price of* ***[SPECIES]*** *is* ***[MARKET PRICE]*** *euros per kilo, if the introduction of a* ***[LABEL]*** *would result in a price increase of* ***[BID]*** *euros per kilo, would you be willing to pay this price to buy this labelled fish?"*. The consumer can answer either "Yes" or "No" to this question. We also provide an "OPT-OUT" option if the consumer feels that the proposed market price for the species is too high. The answer to this first question determines the second bid asked. If the consumer answers "Yes", the same question is asked, but with a higher bid amount. For example, if the first bid amount is €2, the second bid amount will be €3. Conversely, if the consumer answers "No" to the first question, the same question is asked but with a lower bid amount. For example, if the first bid amount is €2, the second bid amount will be €1 (see Figure 3.1). Note that each consumer in our survey had to repeat this double-bounded process twice. We refer to these as "Auction 1" and "Auction 2".

Given our hypothesis, we have chosen to vary certain attributes in these auctions. These attributes are identified in bold in the previous paragraph and in Figure 3.1. In order to assess the potential influence of production methods on WTP, we have included two species: salmon and cod. As mentioned, one is mainly produced by aquaculture (salmon), while the other is mainly wild-sourced (cod). Note that the species presented to one consumer remains stable between "Auction 1" and "Auction 2". The starting prices of the auctions were set at €17.5 per kg for both species. This corresponds to the average price for these fresh species on the French market in 2021, according to FranceAgrimer data (FranceAgrimer, 2022). Additionally, three levels of labelling were considered: one ecolabel, one safety label, and the two labels simultaneously. "Auction 1" concerned either ecolabels or safety labels, while "Auction 2" concerned only double-labelled FAPs. Finally, three distinct "bid amount sets" were employed. These "bid amount sets" include overlapping ranges to enhance our WTP estimation's efficiency, as Alberini (1995) discussed. The proposed "bid amount set" remains stable between "Auction 1" and "Auction 2". All these attributes and their levels are presented in Table 3.1.

**Table 3.1 - Attributes and levels of attributes**

| Attributes | Description of attributes |
|---|---|
| Species | Cod; Salmon |
| Market prices | €17,5 per kilos |
| Labels | Ecolabel, Safety label, Both schemes |
| Bid amount sets | (1,2,0.5) ; (2,3,1) ; (3,4,2) |

Source - FORESEA 2050 database

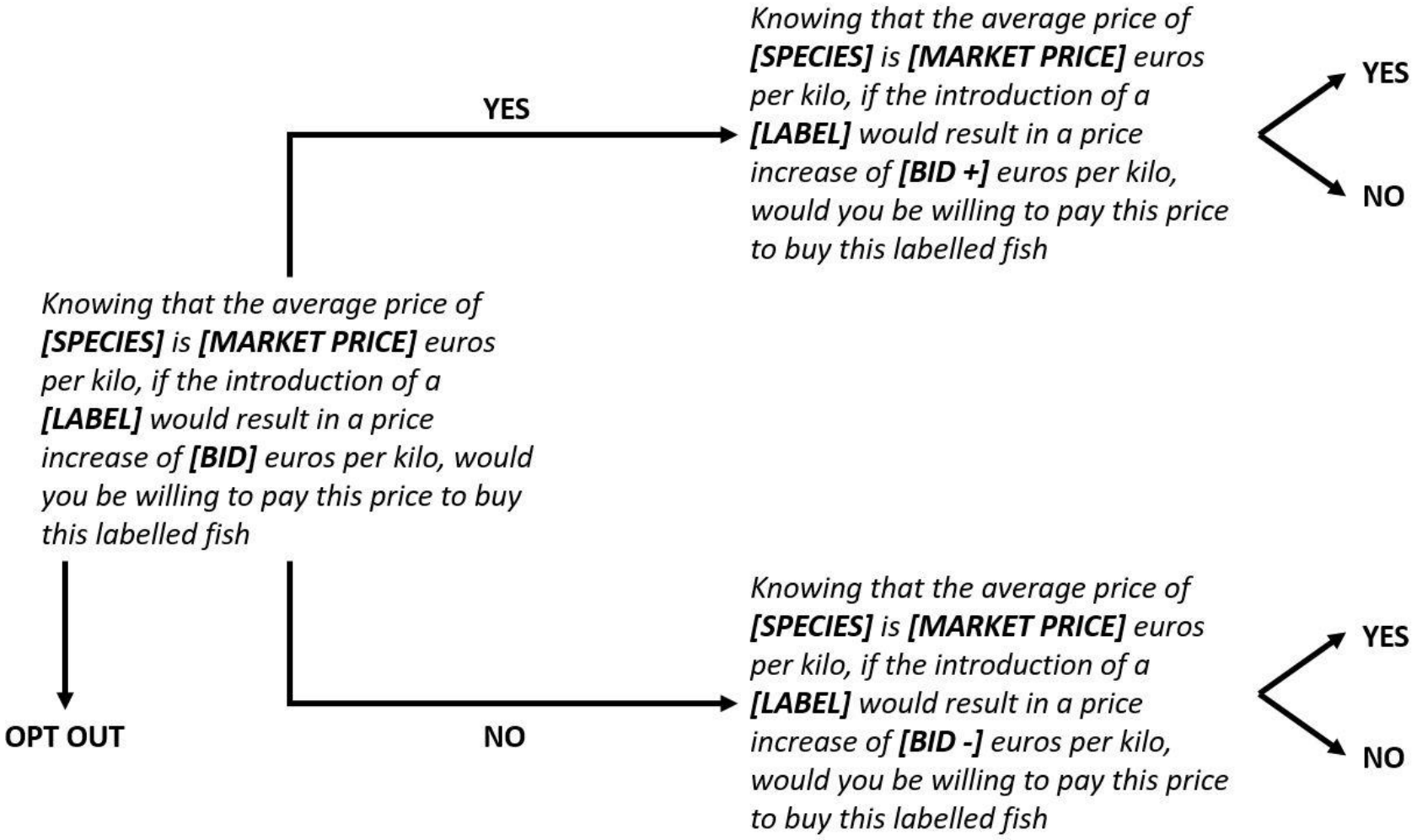


**Figure 3.1 - The double-bounded process**
Source - Authors' elaboration

Prior to the auction part, we provide consumers with information about what we consider to be ecolabels and safety labels in our survey. These labels were presented to consumers as credible and trustworthy, as we know that trust is an important component of label acceptance (Siriex *et al.*, 2013). The definitions given to consumers were:

- **Ecolabels**: identify FAPs that guarantee the use of techniques that respect the environment and resources.
- **Safety labels**: identify FAPs that do not contain toxic substances, hormones and antibiotics.

To measure the impact of production methods and avoid confusion among consumers, we also inform them that salmon is a farmed species and cod is a wild species. Although we aim to measure the impact of the production method, including these two reference species seemed essential to bring consumers closer to a real shopping situation. Our aim was to establish a common reference point for all individuals. It should be noted that we chose to work on hypothetical schemes to avoid the anchoring bias associated with label recognition. Indeed, we know from the results of FranceAgriMer (2019) that this bias is important in the French FAP market.

As Hanemann *et al.* (1991) and Lopez-Feldman (2012) discussed, the DBCM has better statistical efficiency and provides more information than the simple-bounded choice. Bateman *et al.* (2001) and Chien *et al.* (2005) highlight that dichotomous choice contingent valuation questions are relatively inefficient in that large sample sizes are required for a given level of estimation precision. Consequently, multiple-bound designs are commonly used to measure WTP for specific goods or services.

3.2.2.2 - Consumers' WTP estimation

Consumers' WTP in a dichotomous model can be modelled as follows:

$$W_i^* = X_i\beta + u_i, u_i \sim N(0, \sigma^2) \quad (1)$$

Where $i$ (1,.., N) is an individual, $W_i$ consumers' latent WTP, $X_i$ is a set of explanatory variables (see data section), $\beta$ are the parameters to be estimated and the error term $u_i$. The error term $u_i$ is normally distributed with a mean of 0 and a variance of $\sigma^2$.

As explained, in the double-bounded model, we have two bid levels defined here as $b_{inz}$, with z = 1,2, the corresponding bid level and n = 1,2,3, the bid amount set. The second bid amount $b_{in2}$ depends on whether or not the first bid amount $b_{in1}$ is accepted. The answer of respondent $i$ to the first bid $b_{in1}$ will be "Yes" if his/her WTP $W_{i1}$ is higher than the first bid amount proposed. Otherwise, his/her response will be "No". In the same line, the answer of respondent $i$ to the second bid $b_{in2}$ will be "Yes" if his/her WTP $W_{i2}$ is higher than the second bid amount $b_{in2}$. Otherwise, his/her response will be "No". We obtain:

$$\text{Bid1: } W_{i1} = 1, \text{ if } W_{i1}^* > b_{in1}, W_{i1} = 0 \text{ otherwise} \quad (2)$$

$$\text{Bid2: } W_{i2} = 1, \text{ if } W_{i2}^* > b_{in2}, W_{i2} = 0 \text{ otherwise} \quad (3)$$

According to Alberini *et al.* (1997), Whitehead (2002) and Salladarré *et al.* (2016), since we are working with pseudo-panel data, we can estimate the probability of respondent i responding "Yes" to the offers with a random probit model.

We were also interested in capturing two effects of potential bias in the DBCM approach highlighted by Chien *et al.* (2005). According to Salladarré *et al.* (2016), it significantly improves the estimation of WTP. The first is the anchoring bias or starting point bias. This bias occurs when consumers anchor their valuation of the attributes to the first bid proposed (Tversky and Kahneman, 1974) because they are uncertain about their accurate valuation. The first bid proposed is interpreted as a price signal. However, all consumers are more or less sensitive to this starting point bias. In our study, we postulated that consumers who believe that labels are an effective means of obtaining information would be more susceptible to anchoring their responses, as they are less likely to have a predetermined WTP. Conversely, other consumers (who believe that labels are an ineffective tool) are less likely to anchor their responses. Indeed, according to Green *et al.* (1998), anchoring effects are more likely to occur when "*primitive beliefs are weak or absent"*. We also wanted to test for shifting effects leading to incentive incompatibility (if the estimated coefficient is negative) or "Yes/Yes" bias (if the estimated coefficient is positive). As discussed by Chien *et al.* (2005), these two effects are distinct, with one being related to bid values and the other being more related to the self-induced shifting process. To include these two parameters in our equation, we draw on the work of Chien *et al.* (2005) and Salladarré *et al.* (2016), as follows:

$$W_{i1}^{*} = X_i\beta + u_i \qquad (4)$$

$$W_{i2}^{*} = \big(1 - \gamma\,(E_i)\big)W_{i1}^{*} + \gamma(E_i)b_{i1} + \delta \qquad (5)$$

With γ the parameter measuring the anchoring weight, δ the parameter measuring the structural shift. In our case, $E_i$ represents the fact that consumers know the production methods associated with the species considered. We have included these two variables in our model.

Finally, we also wanted to test whether the bid amount proposed to consumers affects their WTP. All the variables included in our work are finally presented in Table 3.A3.

## 3.3 - Results

### 3.3.1 - Bounded process descriptive statistics

A preliminary analysis of consumer responses in the double-bounded process (Table 3.2) reveals that 47% of respondents responded positively to the initial bid, with no statistically significant difference between the two species (48% for salmon and 46.9% for cod). This trend may be due to the equivalent starting market price. It is noteworthy that 20% of the individuals in the sample selected the "opt-out" option. This result indicates that salmon and cod are species that are not affordable for a part of the French population, especially in the global context of limited purchasing power. As expected, our findings indicate that a higher auction price reduces the acceptance of the first bid. For instance, 57.5% of individuals accepted the one-euro bid for cod, while only 35.9% accepted the three-euro bid. This observation is consistent with the findings of Salladarré *et al.* (2016).

The percentages reported in the column labelled "second bid" are conditional and depend on the responses provided to the first bid. Nevertheless, we do not observe an explicit "bid amount" effect on the second bid, regardless of the species considered. Indeed, the frequency of "Yes" does not decrease with increasing bid amount. One possible explanation, as suggested by Bateman *et al.* (2001), is that the distribution of underlying preferences implied by the responses to the first question may differ from that implied by the entire sequence of responses. This hypothesis is presented by Salladarré *et al.* (2016).

**Table 3.2 - Bid value sets and bid responses for salmon and cod WTPs**

| | | **First Bid** | | | **Second Bid** | | | |
|---|---|---|---|---|---|---|---|---|
| Bid-value sets | Total (%) | Yes (%) | No (%) | Opt-out (%) | Yes/Yes (%) | Yes/No (%) | No/Yes (%) | No/No (%) |
| Total (*N=1 895*) | | | | | | | | |
| (1,2,0.5) | 33.6 | 56 | 25 | 19 | 65.6 | 34.4 | 40.3 | 59.7 |
| (2,3,1) | 33.4 | 45.9 | 34.3 | 19.8 | 65.5 | 34.5 | 44.7 | 55.3 |
| (3,4,2) | 33 | 40.3 | 37.7 | 22 | 69.8 | 30.2 | 26.3 | 73.7 |
| Total | 100 | 47.4 | 32.3 | 20.3 | 66.7 | 33.3 | 36.4 | 63.6 |
| Salmon (*N=942*) | | | | | | | | |
| (1,2,0.5) | 33.4 | 54.6 | 26 | 19.4 | 70.4 | 29.6 | 40.2 | 59.8 |
| (2,3,1) | 34.1 | 44.5 | 34.6 | 20.9 | 70.6 | 29.4 | 48.6 | 51.4 |
| (3,4,2) | 32.5 | 44.8 | 37.6 | 17.6 | 69.3 | 30.7 | 24.3 | 75.7 |
| Total | 100 | 48 | 32.7 | 19.3 | 70.1 | 29.9 | 37.3 | 62.7 |
| Cod (*N=953*) | | | | | | | | |
| (1,2,0.5) | 33.8 | 57.5 | 23.9 | 18.6 | 61.1 | 39.9 | 40.3 | 59.7 |
| (2,3,1) | 32.6 | 47.3 | 34.1 | 18.6 | 60.5 | 39.5 | 40.6 | 59.4 |
| (3,4,2) | 33.6 | 35.9 | 37.8 | 26.3 | 70.4 | 29.6 | 28.1 | 71.9 |
| Total | 100 | 46.9 | 31.9 | 21.2 | 63.3 | 36.7 | 35.5 | 64.5 |

Source - FORESEA 2050 database

### 3.3.2 - Results from the probit model

The models allow us to examine the influence of consumer characteristics on WTP for mono-labelled FAPs (Table 3.3) and for double-labelled FAPs (Table 3.4). Overall, these tables confirm our hypothesis [H1] regarding the influence of socio-demographic variables on WTP.

First, the model confirms that the higher the bid amount is, the lower the bid acceptance rate, regardless of the species and labels involved (including double labels). This result is consistent with those previously reported by Salladarré *et al.* (2016) and Janßen and Langen (2017).

**Table 3.3 - Determinants of WTP on mono-labelled fresh salmon and cod**

| | Salmon | | | | Cod | | | |
|---|---|---|---|---|---|---|---|---|
| | Ecolabel | | Safety | | Ecolabel | | Safety | |
| | Coef | Stand. Err | Coef | Stand. Err | Coef | Stand. Err | Coef | Stand. Err |
| **Price** | -0.26** | 0.11 | -0.24 | 0.11 | -0.13 | 0.10 | -0.01 | 0.09 |
| **Knowledge** | | | | | | | | |
| Subjective | -0.05 | 0.05 | 0.07 | 0.06 | 0.17*** | 0.06 | 0.13** | 0.07 |
| Objective | -0.05 | 0.10 | 0.07 | 0.11 | 0.31** | 0.13 | -0.03 | 0.10 |
| Species | -1.08 | 0.96 | 0.49 | 0.98 | -0.48 | 1.15 | 0.17 | 1.29 |
| **Motivation** | | | | | | | | |
| Universalism | -0.22 | 0.37 | -0.53 | 0.38 | -1.39*** | 0.50 | 0.42 | 0.40 |
| Tradition | -0.16 | 0.33 | 0.03 | 0.32 | -0.79** | 0.36 | 0.18 | 0.32 |
| Health | 0.21 | 0.37 | 0.24 | 0.40 | 3.27*** | 0.49 | -0.02 | 0.40 |
| **PCE** | -1.22*** | 0.46 | -1.08** | 0.55 | -5.29*** | 0.60 | -1.57*** | 0.58 |
| **Age (Ref [18-34])** | | | | | | | | |
| [35-49] | -0.34 | 0.71 | -1.00 | 0.72 | -2.94*** | 0.82 | 0.92 | 0.61 |
| [50-64] | -2.55*** | 0.83 | -1.05 | 0.75 | -1.20* | 0.87 | 0.02 | 0.76 |
| 65+ | -0.15 | 0.75 | -0.32 | 0.76 | -4.58*** | 1.03 | -1.73** | 0.81 |
| **Female** | 0.95* | 0.55 | 0.66 | 0.51 | 0.25 | 0.57 | 0.49 | 0.49 |
| **Coastal dep.** | -0.45 | 0.49 | -0.20 | 0.49 | 0.94 | 0.59 | -0.22 | 0.48 |
| **Children** | 1.70*** | 0.63 | 0.14 | 0.56 | -0.86 | 0.75 | -0.78 | 0.56 |
| **Income (ref <1799 euros)** | | | | | | | | |
| [1800 - 2799 euros] | -0.04 | 0.68 | 0.31 | 0.67 | -0.93 | 0.80 | 2.15** | 0.85 |
| [>2800 euros] | -0.72 | 0.63 | 1.55** | 0.68 | -3.48 | 0.81 | 1.70** | 0.77 |
| **Bid am.** | -6.55*** | 1.01 | -6.13*** | 1.11 | -15.35*** | 1.39 | -5.74*** | 1.18 |
| **Anchoring** | 1.08*** | 0.16 | 0.99*** | 0.18 | 2.46*** | 0.21 | 0.95*** | 0.19 |
| **Bid 1** | 18.27*** | 2.36 | 15.98*** | 2.51 | 39.78*** | 2.86 | 14.48*** | 2.67 |
| **Const** | -3.82*** | 1.24 | -5.65*** | 1.56 | -13.74*** | 1.44 | -8.17*** | 1.91 |
| Random intercept. | 2.77 | 0.27 | 2.72 | 0.33 | 4.71 | 0.16 | 2.50 | 0.39 |
| Nb of observations | 465 | | 477 | | 479 | | 474 | |
| Log-likehood | -251.82 | | -290.31 | | -297.31 | | -270.66 | |
| AIC-BIC | 545 - 647 | | 622 - 724 | | 636 - 738 | | 583 - 685 | |

Source - FORESEA 2050 database. *Note: *** $p < 0.01$ ; ** $p < 0.05$; $p < 0.1$*

**Table 3.4 - Determinants of WTP on double-labelled fresh salmon and cod.**

| | Salmon | | Cod | |
|---|---|---|---|---|
| | Coef | Stand. Err | Coef | Stand. Err |
| **Price** | -0.16* | 0.07 | -0.02 | 0.06 |
| **Knowledge** | | | | |
| Subjective | -0.02 | 0.04 | 0.05 | 0.03 |
| Objective | 0.04 | 0.07 | 0.04 | 0.06 |
| Species | 1.20* | 0.65 | 0.22 | 0.77 |
| **Motivations** | | | | |
| Universalism | -0.31 | 0.25 | 0.08 | 0.23 |
| Tradition | -0.03 | 0.21 | -0.08 | 0.19 |
| Health | 0.13 | 0.26 | 0.34 | 0.26 |
| **PCE** | -1.16** | 0.35 | -1.36*** | 0.32 |
| **Age (Ref [18-34])** | | | | |
| [35-49] | -0.07 | 0.47 | -0.60 | 0.41 |
| [50-64] | -1.32** | 0.54 | -1.48** | 0.50 |
| 65+ | 0.31 | 0.51 | -1.66*** | 0.51 |
| **Female** | -0.20 | 0.34 | 0.49 | 0.30 |
| **Coastal dep.** | -0.09 | 0.33 | -0.15 | 0.30 |
| **Children** | 0.25 | 0.38 | -0.25 | 0.34 |
| **Income (Ref < 1 799 euros)** | | | | |
| [1800 - 2799 euros] | 0.56 | 0.47 | -0.02 | 0.40 |
| [>2800 euros] | 1.02** | 0.44 | -0.16 | 0.39 |
| **Bid am.** | -5.91*** | 0.68 | -4.96*** | 0.60 |
| **Anchoring** | 0.95*** | 0.11 | 0.85*** | 0.10 |
| **Bid 1** | 15.82*** | 1.52 | 13.24*** | 1.41 |
| **Const** | -5.01*** | 0.98 | -5.44*** | 0.83 |
| **Random intercept.** | 2.72 | 0.20 | 2.29 | 0.23 |
| Nb of observations | 942 | | 953 | |
| Log-likehood | -564.63 | | -549.02 | |
| AIC-BIC | 1171 - 1287 | | 1140 - 1256 | |

Source - FORESEA 2050 database

*Note: *** p < 0.01 ; ** p < 0.05; p<0.1*

As FAPs are often perceived as expensive and labels are often associated with a price premium, we expected to observe price and income effects. First, it was hypothesised that consumers who pay attention to price when purchasing FAPs will have a lower WTP for labels. This relationship is confirmed for both ecolabelled and double-labelled salmon. We also find noteworthy income effects. Compared to households with an income below 1,799 euros per month, households with a higher income tend to have a higher WTP for safety labels, except for salmon and middle-income households. It is noteworthy that this effect is not observed for ecolabels. It can be argued that high income is a necessary but insufficient condition to explain consumers' higher WTP for ecolabels. We also observe that households with an income above 2,799 euros tend to have a higher WTP for double-labelled salmon.

Knowledge is deeply linked to food choice behaviour (Pieniak *et al.*, 2013; Menozzi *et al.*, 2023). In this paper, we are interested in three types of knowledge: subjective knowledge, objective knowledge and species-specific knowledge. Subjective knowledge increases the WTP of ecolabels and safety labels on cod, whereas objective knowledge increases the WTP for ecolabelled cod. Finally, consumers with specific knowledge about salmon tend to have a higher WTP for double-labelled products.

Motivations are also an interesting predictor concerning labelled FAPs preferences (Brécard *et al.*, 2012; Zander and Feucht, 2018). Surprisingly, our results show that demonstrating a high degree of altruism reduces WTP for ecolabels on cod, in contrast to the findings of Brécard *et al.* (2012). In the existing literature, universalism is often described as a predictor of pro-environmental behaviour (Hasselbach and Roosen, 2015; Zander and Feucht, 2018). In addition, our results show that an attachment to tradition is negatively correlated with WTP for ecolabels. This phenomenon can be attributed to the questioning of traditional practices in the context of introducing more environmentally friendly production methods (Salladarré *et al.*, 2010). Finally, health involvement is associated with a higher WTP for cod with ecolabels, underlying potential cross-motivations, in line with the findings of Jacobs *et al.* (2015), who state that green consumption can also be motivated by health considerations. Nevertheless, this relation is not present for salmon.

A higher degree of PCE is often associated with sustainable consumption behaviour and a higher WTP for ecolabelled FAPs (Zander and Feucht, 2018). However, our results do not support this hypothesis. Our survey results indicate that PCE reduces consumers' WTP for all products tested, regardless of species or labels.

Looking at our socio-demographic variables, we find that age influences the stated WTP. Indeed, individuals aged between 50 and 64 (in the case of salmon) are willing to pay less for an ecolabel than the younger generation. This link is also confirmed for cod and consumers over 35. This result can be explained by the fact that the younger generation is more likely to adopt environmentally conscious behaviours than the older generation (Ivanova *et al.*, 2019). When we focus on double-labelled FAPs, we also find that the older generation may be less interested in these products. A possible explanation for this

discrepancy is that the older generation may be less receptive to this innovative approach. The presence of children in the household is associated with a higher willingness to pay (WTP) for ecolabelled salmon. However, this effect is not observed for other products. This is somewhat surprising, as the presence of children is often associated with a higher preference for labelled products, which may be attributed to the association of labels with high-quality products. Finally, we observe that women tend to have a higher WTP for ecolabelled salmon.

Globally, some of our results may seem surprising when we look at the existing literature on consumers' preferences for labelled FAPs. Salladarré *et al.* (2016) note that profiles may differ from those expressed in preferences due to budgetary constraints, which may hinder the translation of preferences into actual financial behaviour.

Finally, two bias-related variables were included in the model. The results showed a heterogeneous anchoring effect for all the combinations tested. Those consumers who perceived labels as an effective information tool were found to anchor their responses to the first offer, as they perceived it as a "price signal" of the correct cost of these labels. Furthermore, a positive and significant coefficient on the structural shift effect was observed in all the results, indicating a significant "Yes/Yes" bias in our results. This underlines that consumers who respond "Yes" to the initial bid are more likely to respond "Yes" to the subsequent one. This effect was anticipated, given that individuals tend to act in a manner perceived as the most desirable when it comes to sustainable behaviour. The "warm glow" effect (Clark *et al.*, 2003) and social pressure (Young *et al.*, 2010) have been identified as drivers of this behaviour. Incorporating these two effects into our model allows us to achieve greater precision in estimating consumers' WTP.

### 3.3.3 - Consumers' WTP

We estimate each label's WTP for fresh salmon and cod products (Table 3.5). Overall, the average WTP for unique labels is positive, meaning that consumers are willing to pay a premium for additional information. This result was expected given the existing work on ecolabels in the FAPs value chain. The average additional WTP is €1.56 per kilo for ecolabels and €1.63 per kilo for safety labels. Despite a marginal difference, consumers are willing to pay more for safety labels than ecolabels. This result is in line with the EU report on consumption drivers (European Commission, 2020), where safety is valued more than environmental attributes in food consumption choices. Pieniak *et al.* (2013) also find a higher interest in health information than in information related to the sustainability of production in several EU countries. Gephart *et al.* (2021) also find a higher interest in health issues than in environmental issues when it comes to FAP consumption.

**Table 3.5– Consumers' WTP for labelled cod and salmon**

| | All species | | | Salmon | | | Cod | | |
|---|---|---|---|---|---|---|---|---|---|
| | WTP | LB | UB | WTP | LB | UB | WTP | LB | UB |
| Ecolabels | 1.56 | 1.52 | 1.60 | 1.52 | 1.44 | 1.60 | 1.60 | 1.56 | 1.63 |
| Safety labels | 1.63 | 1.56 | 1.68 | 1.81 | 1.73 | 1.89 | 1.45 | 1.35 | 1.53 |
| Both labels | 1.59 | 1.54 | 1.63 | 1.68 | 1.62 | 1.73 | 1.55 | 1.46 | 1.61 |

Source - FORESEA 2050 database
*Note: Market price for both species = €17.50 per kg, from FranceAgriMer (2022)*
*Krinsky and Robb (95 %) Confidence Interval for WTP measures*

In our case, it is more interesting to look at the species level. The additional WTP for ecolabelled salmon is €1.52 per kilo, and for safety labels, it is €1.81 per kilo. This result is interesting when we compare it to those of Fonner and Sylvia (2015). Indeed, they find the reverse WTP regarding these two labels (higher WTP for ecolabels compared to safety labels), but for wild salmon. We also find an additional WTP of €1.60 per kilo for ecolabelled cod and €1.45 per kilo for cod with safety labels. As hypothesised in **[H2]**, these crossed results underline a "production method" effect on stated WTP.

Let us start by discussing the results of salmon. We know that consumers express strong concerns about the safety of farmed seafood, notably linked to their association with livestock production (Verbeke *et al.*, 2007b). Indeed, 69.6 % of French consumers believe that *"farmed seafood is produced industrially",* and 68.4 % believe that *"fish farming uses too many drugs"* (Feucht *et al.*, 2017). This negative perception is reflected in consumers' WTP for safety labels, which is the highest WTP according to our results. Consumers are ready to pay a significant additional price to ensure that their salmon is safe. Note that consumers' WTP for ecolabelled salmon, although lower, is significant, indicating that consumers also perceive potential environmental risks associated with aquaculture production. In this line, 41.8% of French consumers agreed with the statement, "*Fish farming endangers the surrounding ecosystem*" (Feucht *et al.*, 2017).

As mentioned above, we find opposite relative effects when looking at French consumers' WTP for cod. Consumers value ecolabels more (+ €1.60 per kilo) than safety labels (+ €1.45 per kilo), suggesting that consumers' concerns about wild species are mainly environmental, as presented in the article by Zander and Feucht (2018). The WTP for safety labels on cod is the lowest of our results. This highlights that, despite a growing awareness of the degradation of the marine environment, the perceived freshness and naturalness of wild species (Verbeke *et al.*, 2007b; Lopez-Mas *et al.*, 2021) may limit consumers' WTP for information on these attributes.

Our hypothesis [**H3**] was that the addition of a second label to FAPs would lead to a decreasing marginal WTP. In other words, we expected the valuation of two labels on the same products to be superior to the WTP for a single label, but inferior to consumers' WTP for these two labels taken separately. However, when comparing the WTP for single-labelled FAPs with the WTP for double-

labelled FAPs, this hypothesis is only partially confirmed. For salmon, we see that WTP is higher for double-labelled products (+ €1.68 per kilo) than for ecolabels alone (+€1.52 per kilo). Adding a safety label to an ecolabelled salmon can therefore increase consumers' WTP (positive interaction). Conversely, the WTP for a safety label alone (+€1.81 per kilo) is higher than for double-labelled products. Adding an ecolabel thus leads to a negative marginal WTP (negative interaction). For cod, WTP is higher for double-labelled products (+ €1.55 per kilo) than for safety labels alone (+ €1.45 per kilo). Adding an ecolabel to a cod with a safety label increases consumers' WTP (positive interaction). Conversely, the WTP for the ecolabel alone (+€1.60 per kilo) is higher than the WTP for double-labelled cod. Adding a safety label to an ecolabelled cod reduces consumers' WTP (negative interaction). We find positive and negative interactions between label associations for both species.

## 3.4 - Policy implications

This study aims to assess consumers' WTP for single and double-labelled FAPs for two specific schemes (safety and ecolabels). For this purpose, declarative survey data are used with a double-bounded approach. The results show several specific features that can be explored to make FAPs production systems more sustainable.

As hypothesised, production methods may influence the stated WTP for labelled FAPs [**H2**]. Indeed, consumers tend to value safety labels more for farmed species and ecolabels more for wild species. For farmed species, this result confirms that consumers still question the health/safety attributes of farmed FAPS, particularly with regard to the use of antibiotics and hormones (Zander and Feucht, 2018). If the EU strategy is to develop the competitiveness of its aquaculture sector[31], it is essential to overcome this perception of aquaculture as risky. Some authors argue that there is no real scientific evidence that farmed species are less safe than wild species (Verbeke *et al.*, 2007b) and that these productions are even more controlled than wild productions (Claret *et al.*, 2014). Education and information resources need to be developed to address this potential misconception about the safety of farmed products. Furthermore, our results show that consumers are also interested in the environmental aspects of aquaculture products. As a highly innovative sector (Afewerki *et al.*, 2023), new forms of aquaculture production, including non-intensive production, can meet both of these consumer demands, as they are often based on reducing the use of hormones and antibiotics, while limiting the impact on the environment. Finally, one potential way to increase consumer acceptance of aquaculture ecolabels is to highlight criteria related to the excessive use of hormones and antibiotics in their standards. While these criteria are often included in existing labels[32], they are often poorly communicated to consumers, who may not be aware of them.

[31] According to the EU strategy for sustainable aquaculture : https://oceans-and-fisheries.ec.europa.eu/ocean/blue-economy/aquaculture_en

[32] The Aquaculture Stewardship Council label (ASC), one of the most widespread ecolabel on the market, is a good example of this reality : https://asc-aqua.org/producers/asc-standards/

In the case of wild species, consumers tend to place greater value on environmental labels than safety labels. Promoting environmentally friendly production methods and labels seems to be a promising strategy to meet consumer expectations. Nevertheless, if ecolabels are already expanding in the market (Lucas *et al.*, 2021), this rapid expansion has led to the entry of "dubious" labels in the market (Grolleau *et al.*, 2016), undermining consumer confidence in these approaches and, in the meantime, limiting the market power of these labels. We therefore argue for the need to introduce a clearer and stricter framework to regulate their proliferation. This framework should serve to prevent the market entry of labels that are not in line with the overall objectives of resource conservation or labels that are not sufficiently demanding in terms of these objectives. Interestingly, despite a lower WTP for safety labels than for ecolabels for wild products, consumers express an interest in them. This may be related to a growing awareness of the deterioration of marine water quality (heavy metals, polychlorinated biphenyls (PCBs), etc.). The issue of the safety of wild FAPs is likely to become increasingly important in the coming years and should be clearly integrated into future policies on the overall sustainability of the fisheries sector.

Overall, these results tend to argue in favour of taking more account of production methods in public food policies on FAPs, particularly in terms of consumer information. While public policies are differentiated at the production level, this is not necessarily the case at the consumption level. FAPs are often treated as a whole. Interestingly, our results show that consumers with high levels of PCE are less likely to seek out labelled FAPs. This may indicate that individuals who believe they can contribute to sustainable development through their personal actions have limited confidence in the effectiveness of labels. This, in turn, reflects the growing distrust of labels among consumers, particularly those concerned with sustainability issues, and underlines the need to reassure them through active information.

While double labelling is becoming increasingly common in the food market, our findings suggest that it should be approached with caution, particularly with regard to the issue of "information hierarchy". While label complementarity is essential in the existing literature (Siriex *et al.*, 2013; Dufeu *et al.*, 2014), this work shows that the success of double labelling initiatives may also depend on: 1) the importance attached to a specific attribute, and 2) the production method under consideration. Indeed, we find that when a primary label related to the most highly valued attributes (environmental concerns for wild species, safety for aquaculture species) is already present on the FAPs, consumers perceive the addition of a secondary label as a disruptive factor, leading to a negative marginal WTP. In this case, the importance attached to the primary information is such that adding additional information reduces the valuation of the product for consumers. This presence of "primary information" allows consumers to reach an "optimal level" of information (Bougherara *et al.*, 2007). Conversely, when the label associated with a secondary attribute is stamped first, adding a second label associated with the most valued attributes leads to positive and decreasing marginal WTP. In this case, double-labelled products

represent an opportunity for producers. Globally, this result underlines that consumers do not necessarily value the communication of too much information (Bougherara *et al.*, 2007). To interest them, it may be more important to communicate the right information/attributes (those most valued).

Nevertheless, double certification offers an interesting potential to guide consumers towards "healthy and sustainable" consumption of FAPs. The question is therefore: "How can these products be better accepted in the FAPs market?". According to our results, the older generation seems to be particularly resistant to these products. Consumers' limited knowledge of FAPs may reinforce this tendency and even lead to adverse selection. However, as Weinstein (1988) discussed,, knowledge is a precursor to action in adopting a new behaviour. Information campaigns, communication and education are therefore essential to increase consumer awareness and potential acceptance of double-labelled FAPs, and targeting the older generation, also known for its high consumption of FAPs, could be interesting.

Furthermore, an interesting point to discuss is also "*the cognitive abilities of consumers who are hindered by an increase in the amount of information provided by the accumulated labels*" (Dufeu *et al.*, 2014). As stated by Sonntag *et al.* (2023), the proliferation of labels can thus lead to information confusion, overload and loss of consumer trust. Our results are consistent with this idea, showing that an increased amount of information does not necessarily lead to a higher consumers' WTP. Nevertheless, the existing literature discusses potential levers to limit this effect. Since consumers have no alternative means of verifying the presence of the credence attributes in the FAP (other than the labels themselves), the success of the dual labelling practice may depend on consumers' perceptions of the trustworthiness of the labels. Indeed, as discussed by Janssen and Hamm (2012), Sirieix *et al.* (2013) and Dufeu *et al.* (2014), label acceptance depends on consumer trust. In this line, Janssen and Hamm (2012) show that the success of label association depends on the recognition of at least one label that consumers identify as 'trustworthy'. Consumers trust independent or public certifiers (Wessells *et al.*, 1999; Janssen and Hamm, 2012) more than private actors. A promising way to increase the acceptance of double-labelled FAPs could be to associate public labels with an established reputation, which may limit the distrust expressed by consumers. Otherwise, strengthening the communication of a single label across multiple dimensions could also be a way forward.

It should also be noted that our approach introduces some bias. The identified "Yes/Yes" bias may lead to overestimating consumers' WTP. Furthermore, our article focuses on a specific market, species, etc. This work also needs to be extended to new markets, species and label combinations to provide more insight into this topic. Finally, as we are working with declarative data, there is a potential behavioural gap between stated preferences and actual consumption behaviour. There is therefore a need for more detailed data on actual purchases of labelled FAPs to compare our findings with the real market situation.

## 3.5 - Conclusion

This article presents an analysis of consumer willingness to pay (WTP) for two unique labels (e.g., ecolabel and safety label) and their potential association with FAPs. Additionally, the study examines the influence of production methods (wild and aquaculture) on consumers' WTP for these labels. The results show that consumers tend to value safety labels for salmon and ecolabels for cod more highly. This suggests that production methods influence consumers' WTP for these labels. We recommend that producers adopt more environmentally friendly production methods and less intensive aquaculture practices to meet consumer expectations. It also highlights the irrelevance of treating FAPs as a homogeneous whole in existing food policies, notably from a consumer perspective.

Secondly, our objective was to determine whether the addition of a second label leads to an increase in consumers' WTP. The results of this study differ depending on the label that is initially displayed on the products. If this label provides information about the attributes that consumers value most regarding the production methods, the addition of a second label leads to a negative WTP from consumers. In this case, the value attributed to the first label is so high that the addition of a second label is perceived as disruptive by consumers. These findings have implications for the entire value chain and demonstrate the potential risks of developing communication around multiple attributes on the same products.

Finally, despite the limitations identified, double-labelled FAPs may be an interesting way to meet consumers' information needs. In this line, we identify strategies to increase the acceptance of double-labelled products, particularly among older consumers who appear to be less receptive to such initiatives. Two key levers are identified. The first is the importance of informing and educating consumers about these initiatives to mitigate this potential mistrust. The second is to rely on labels that consumers identify as trustworthy to increase their interest.

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## 3.6 - Appendix

**Table 3.A1 - Questions used for measuring consumers' objective knowledge of the sector**

| Questions | Answers |
|---|---|
| The production method (wild or farmed) is mandatory information on seafood products sold fresh. | True |
| The quantity of OMEGA 3 present in fish does not depend on the species. | False |
| Cod and "Morue" are the same species | True |
| Haddock and hake are the same species | False |
| Saithe is a freshwater species | False |
| Oils and meals from wild fish are used as feed for farmed fish | True |
| As with fruit and vegetables, there are seasons for fish | True |
| Anchovies, mackerel and sardines belong to the family of small pelagic fish. | True |
| Monkfish can be described as an invasive species | False |
| The colour of a salmon fillet cannot be changed by its diet | False |
| In the wild, cod generally travel in shoals. | True |

Source - FORESEA 2050 database

**Table 3.A2 - Factoring method and associated test results**

| Question used | Most significant variables | Constructed variables | Cronbac's alpha statistic | KMO test |
|---|---|---|---|---|
| Factor analysis #1<br>"I kike ..."<br>(1) to take care of nature<br>(2) to fight against threats to nature<br>(3) to protect the environment | +(1) (2) (3) | *Universalism* | 0.78 | 0.75 |
| Factor analysis #2<br>"I kike ..."<br>(1) to maintain traditional beliefs and values<br>(2) to follow traditions<br>(3) to value traditional practices | +(1) (2) (3) | *Tradition* | 0.84 | 0.72 |
| Factor analysis #3<br>(1) He/she pays attention to his/her food choices for better health<br>(2) It is important for him/her to avoid processed foods, which are too rich in salt, sugar, etc.<br>(3) He/she pays attention to the risks of contamination present in food | +(1) (2) (3) | *Health* | 0.78 | 0.69 |
| Factor analysis #4<br>(1) By buying sustainable seafood, I can help limit the environmental impact of fishing and aquaculture<br>(2) Whenever I can, I choose sustainable seafood<br>(3) My choice of seafood products has no influence on the sustainability of fisheries<br>(4) There's nothing I can do about the depletion of natural fish stocks<br>(5) Labels are an effective consumer information tool | + (1) (2) (5) | *PCE* | 0.74 | 0.75 |

Source - FORESEA 2050 database

*Note: To determine the internal consistency of items, we use Cronbach's alpha statistic. A score of 0.7 is an acceptably reliable coefficient, but lower thresholds are sometimes used in the literature (see Nunnaly.C (1978)). Factors with an eigenvalue over one are retained. The Bartlett test is Bartlett's test of sphericity and KMO is the Kaiser-Meyer-Olkin measure*

**Table 3.A3 - Description and summary statistics of the variables.**

| Variable | Description | Mean | SD |
|---|---|---|---|
| Price | Price is an important buying criterion for FAPs | 6.36 | .058 |
| Subjective | The respondent believes he/she has specific knowledge of the sector | 12.70 | .115 |
| Objective | The respondent has knowledge of the sector | 5.72 | 0.59 |
| Species | The respondent knows the species (salmon or cod) and it's market characteristics | 0.055 | .005 |
| Universalism | The respondent demonstrates a high degree of universalism (Factor) | -1.10e-08 | .021 |
| Tradition | The respondent demonstrates a high attachment to tradition (Factor) | 2.45e-09 | .021 |
| Health inv. | The respondent is interested in the health aspects of their diet (Factor) | 5.92e-09 | .020 |
| PCE | The respondent believes that his or her consumption choices can change the future of the planet (Factor) | 7.75 e-10 | .019 |
| [18-34] | The respondent is between 18 and 34 years old | 0.442 | .011 |
| [35-49] | The respondent is between 35 and 49 years old | 0.186 | .009 |
| [50-64] | The respondent is between 50 and 64 years old | 0.184 | .009 |
| [64+] | The respondent is over 65 | 0.188 | .009 |
| Female | The respondent is a female | 0.529 | .011 |
| Coastal dep. | The respondent lives in a coastal department | 0.394 | .011 |
| Children | The respondent has dependent children at home | 0.394 | .011 |
| [< 1799 €] | The household earns less than 1800 euros per month | 0.240 | .010 |
| [1800-2799 €] | The household earns between 1800 and 2800 euros per month | 0.303 | .011 |
| [> 2800 €] | The household earns more than 2 800 euros per month | 0.456 | .011 |
| Bid am. | Bid amount proposed in the two auctions | 1.68 | .020 |
| Anchoring | Respondent anchors his answer to the first bid | 7.88 | .099 |
| Bid 1 | Yes:Yes bias measurement | 0.474 | .008 |

Source - FORESEA 2050 database

## 3.7 - References

**Afewerki, S., Asche, F., Misund, B., Thorvaldsen, T., & Tveteras, R.** (2023). Innovation in the Norwegian aquaculture industry. *Reviews in Aquaculture*, *15*(2), 759–771. https://doi.org/https://doi.org/10.1111/raq.12755

**Alberini, A.** (1995). Optimal designs for discrete choice contingent valuation surveys: Single-bound, double-bound, and bivariate models. In *Journal of Environmental Economics and Management* (Vol. 28, Issue 3, pp. 287–306). https://doi.org/https://doi.org/10.1006/jeem.1995.1019

**Alberini, A., Kanninen, B., & Carson, R. T. (1997).** Modeling Response Incentive Effects in Dichotomous Choice Contingent Valuation Data. *Land Economics*, *73*(3), 309–324. https://doi.org/https://doi.org/10.2307/3147170

**Asche, F., Larsen, T. A., Smith, M. D., Sogn-Grundvåg, G., & Young, J. A.** (2015). Pricing of eco-labels with retailer heterogeneity. *Food Policy*, *53*, 82–93. https://doi.org/https://doi.org/10.1016/j.foodpol.2015.04.004

**Aschemann-Witzel, J., Maroscheck, N., & Hamm, U.** (2013). Are organic consumers preferring or avoiding foods with nutrition and health claims? *Food Quality and Preference*, *30*(1), 68–76. https://doi.org/10.1016/j.foodqual.2013.04.011

**Banovic, M., Reinders, M. J., Claret, A., Guerrero, L., & Krystallis, A.** (2019). A cross-cultural perspective on impact of health and nutrition claims, country-of-origin and eco-label on consumer choice of new aquaculture products. *Food Research International*, *123*(January), 36–47. https://doi.org/10.1016/j.foodres.2019.04.031

**Bateman, I. J., Langford, I. H., Jones, A. P., & Kerr, G. N.** (2001). Bound and path effects in double and triple bounded dichotomous choice contingent valuation. *Resource and Energy Economics*, *23*(3), 191–213. https://doi.org/https://doi.org/10.1016/S0928-7655(00)00044-0

**Barreiro-Hurlé, J., Gracia, A., & de Magistris, T.** (2008). *When more is less: the effect of multiple health and nutritional labels in food product choice* (2008 International Congress, August 26-29, 2008, Ghent, Belgium, Issue 44013). European Association of Agricultural Economists. https://econpapers.repec.org/RePEc:ags:eaae08:44013

**Bennett, A., Basurto, X., Virdin, J., Lin, X., Betances, S. J., Smith, M. D., Allison, E. H., Best, B. A., Brownell, K. D., Campbell, L. M., Golden, C. D., Havice, E., Hicks, C. C., Jacques, P. J., Kleisner, K., Lindquist, N., Lobo, R., Murray, G. D., Nowlin, M., … Zoubek, S.** (2021). Recognize fish as food in policy discourse and development funding. *Ambio*, *50*(5), 981–989. https://doi.org/10.1007/s13280-020-01451-4

**Bougherara, D., Grolleau, G., & Mzoughi, N.** (2007). Is more information always better? An analysis applied to information-based policies for environmental protection. *International Journal of Sustainable Development*, *10*(3), 197–213. https://doi.org/10.1504/IJSD.2007.017643

**Brécard, D., Hlaimi, B., Lucas, S., Perraudeau, Y., & Salladarré, F.** (2009). Determinants of demand for green products: An application to eco-label demand for fish in Europe. *Ecological Economics*, *69*(1), 115–125. https://doi.org/10.1016/j.ecolecon.2009.07.017

**Brécard, D., Lucas, S., Pichot, N., & Salladarré, F.** (2012). Consumer preferences for eco, health and fair trade labels. An application to seafood products in France. *Journal of Agricultural and Food Industrial Organization*, *10*(1). https://doi.org/https://doi.org/10.1515/1542-0485.1360

**Bronnmann, J., & Asche, F.** (2016). The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany. *Journal of Agricultural Economics*, *67*(1), 231–244. https://doi.org/https://doi.org/10.1111/1477-9552.12138

**Carlucci, D., Nocella, G., De Devitiis, B., Viscecchia, 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/https://doi.org/10.1016/j.appet.2014.10.008

**Chien, Y. L., Huang, C. J., & Shaw, D.** (2005). A general model of starting point bias in double-bounded dichotomous contingent valuation surveys. *Journal of Environmental Economics and Management*, *50*(2), 362–377. https://doi.org/https://doi.org/10.1016/j.jeem.2005.01.002

**Claret, A., Guerrero, L., Ginés, R., Grau, A., Hernández, M. D., Aguirre, E., Peleteiro, J. B., Fernández-Pato, C., & Rodríguez-Rodríguez, C.** (2014). Consumer beliefs regarding farmed versus wild fish. *Appetite*, *79*, 25–31. https://doi.org/10.1016/j.appet.2014.03.031

**Clark, C. F., Kotchen, M. J., & Moore, M. R.** (2003). Internal and external influences on pro-environmental behaviour: Participation in a green electricity program. *Journal of Environmental Psychology*, *23*(3), 237–246. https://doi.org/https://doi.org/10.1016/S0272-4944(02)00105-6

**Crona, B. I., Daw, T. M., Swartz, W., Norström, A. V, Nyström, M., Thyresson, M., Folke, C., Hentati-Sundberg, J., Österblom, H., Deutsch, L., & Troell, M.** (2016). Masked, diluted and drowned out: how global seafood trade weakens signals from marine ecosystems. *Fish and Fisheries*, *17*(4), 1175–1182. https://doi.org/https://doi.org/10.1111/faf.12109

**De Bauw, M., Matthys, C., Poppe, V., Franssens, S., & Vranken, L.** (2021). A combined Nutri-Score and 'Eco-Score' approach for more nutritious and more environmentally friendly food choices? Evidence from a consumer experiment in Belgium. *Food Quality and Preference*, *93*(October), 104276. https://doi.org/10.1016/j.foodqual.2021.104276

**Dufeu, I., Ferrandi, J.-M., Gabriel, P., & Le Gall-Ely, M.** (2014). Socio-environmental multi-labelling and consumer willingness to pay. *Recherche et Applications En Marketing*, *29*(3), 35–56. https://doi.org/https://doi.org/10.1177/2051570714542063

**EUMOFA.** (2022). *The EU fish market – 2022 edition*. https://doi.org/10.2771/716731

**European Commission.** (2020). *Special Eurobarometer 505: Making our food fit for the future - Citizens' expectations* (Issue September). https://ec.europa.eu/commfrontoffice/publicopinion

**FAO.** (2018). Sustainable food systems - Concept and framework. In *FAO pbrief*. http://www.fao.org/3/ca2079en/CA2079EN.pdf

**FAO.** (2020). *The State of World Fisheries and Aquaculture 2020. Sustainability in action.* https://doi.org/https://doi.org/10.4060/ca9229en

**FAO.** (2022). *The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation*. https://doi.org/https://doi.org/10.4060/cc0461en

**Feucht, Y., Zander, K., Gallic, B., Nourry, M., Masson, E., Pirrone, C., Avdelas, L., & Galinou-Mitsoudi, S.** (2017). *Deliverable: D2.2 - Results on consumer preferences for sustainable seafood products from Europe*. https://cordis.europa.eu/project/id/635188

**Fonner, R., & Sylvia, G.** (2015). Willingness to Pay for Multiple Seafood Labels in a Niche Market. *Marine Resource Economics*, *30*(1), 51–70. https://doi.org/10.1086/679466

**FranceAgrimer.** (2019). *Aquatic products image barometer - Study report - December 2019*. https://www.franceagrimer.fr/fam/content/download/63160/document/Synthèse FranceAgrimer - V2 2019.pdf?version=2

**FranceAgrimer.** (2022). *Consumption of fishery and aquaculture products 2021 - Study report*. https://doi.org/10.3917/iris.abis.2021.01.0351

**FranceAgriMer.** (2023). *The fisheries and aquaculture sector in France (2023)*. https://www.franceagrimer.fr/fam/content/download/67049/document/STA_MER_chiffres_cles_english.pdf?version=2

**Gephart, J. A., Henriksson, P. J. G., Parker, R. W. R., Shepon, A., Gorospe, K. D., Bergman, K., Eshel, G., Golden, C. D., Halpern, B. S., Hornborg, S., Jonell, M., Metian, M., Mifflin, K., Newton, R., Tyedmers, P., Zhang, W., Ziegler, F., & Troell, M.** (2021). Environmental performance of blue foods. *Nature*, *597*(7876), 360–365. https://doi.org/10.1038/s41586-021-03889-2

**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. https://doi.org/10.1017/S0007114520003773

**Green, D., Jacowitz, K. E., Kahneman, D., & Mcfadden, D.** (1998). Referendum contingent valuation, anchoring, and willingness to pay for public goods. *Resource and Energy Economics*, *20*(2), 85–116. https://doi.org/https://doi.org/10.1016/S0928-7655(97)00031-6

**Grolleau, G., Ibanez, L., Mzoughi, N., & Teisl, M.** (2016). Helping eco-labels to fulfil their promises. *Climate Policy*, *16*(6), 792–802. https://doi.org/10.1080/14693062.2015.1033675

**Grunert, K. G.** (2011). Sustainability in the Food Sector: A Consumer Behaviour Perspective. *International Journal on Food System Dynamics*, *2*(3), 207–218. https://doi.org/10.18461/ijfsd.v2i3.232

**Hanemann, M., Loomis, J., & Kanninen, B.** (1991). Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation. *American Journal of Agricultural Economics*, *73*(4), 1255–1263. https://doi.org/https://doi.org/10.2307/1242453

**Hasselbach, J. L., & Roosen, J.** (2015). Consumer Heterogeneity in the Willingness to Pay for Local and Organic Food. *Journal of Food Products Marketing*, *21*(6), 608–625. https://doi.org/https://doi.org/10.1080/10454446.2014.885866

**Ivanova, O., Flores-Zamora, J., Khelladi, I., & Ivanaj, S.** (2019). The generational cohort effect in the context of responsible consumption. *Management Decision*, *57*(5), 1162–1183. https://doi.org/https://doi.org/10.1108/MD-12-2016-0915

**Jacobs, S., Sioen, I., Pieniak, Z., De Henauw, S., Maulvault, A. L., Reuver, M., Fait, G., Cano-Sancho, G., & Verbeke, W.** (2015). Consumers' health risk-benefit perception of seafood and attitude toward the marine environment: Insights from five European countries. *Environmental Research*, *143*(B), 11–19. https://doi.org/https://doi.org/10.1016/j.envres.2015.02.029

**Janßen, D., & Langen, N.** (2017). The bunch of sustainability labels – Do consumers differentiate? *Journal of Cleaner Production*, *143*, 1233–1245. https://doi.org/10.1016/j.jclepro.2016.11.171

**Janssen, M., & Hamm, U.** (2012). Product labelling in the market for organic food: Consumer preferences and willingness-to-pay for different organic certification logos. *Food Quality and Preference*, *25*(1), 9–22. https://doi.org/http://dx.doi.org/10.1016/j.foodqual.2011.12.004

**Kim, Y., & Choi, S. M.** (2005). Antecedents of Green Purchase Behaviour : An Examination of Collectivism , Environmental Concern , and Perceived Consumer Effectiveness. *Advances in Consumer Research*, *32*(August), 592–599. https://www.tcrwebsite.org/volumes/9156/volumes/v32/NA-32

**Kushwah, S., Dhir, A., Sagar, M., & Gupta, B.** (2019). Determinants of organic food consumption. A systematic literature review on motives and barriers. *Appetite*, *143*, 104402. https://doi.org/https://doi.org/10.1016/j.appet.2019.104402

**Lang, M. F., & Rodrigues, A. C.** (2021). How the Structure of Benefits for Sustainably Raised Seafood May Differ in the USA: Implications for Wider Market Adoption. *Journal of International Food and Agribusiness Marketing*, *33*(1), 84–103. https://doi.org/10.1080/08974438.2020.1860856

**Lopez-Feldman, A.** (2012). *Introduction to contingent valuation using Stata*. https://mpra.ub.uni-muenchen.de/41018/

**López-Mas, L., Claret, A., Reinders, M. J., Banovic, M., Krystallis, A., & Guerrero, L.** (2021). Farmed or wild fish? Segmenting European consumers based on their beliefs. *Aquaculture*, *532*(June 2020), 735992. https://doi.org/10.1016/j.aquaculture.2020.735992

**Lucas, S., Soler, L.-G., & Revoredo-Giha, C.** (2021). Trend analysis of sustainability claims: The European fisheries and aquaculture markets case. *Food Policy*, *104*(July), 102141. https://doi.org/https://doi.org/10.1016/j.foodpol.2021.102141

**Maesano, G., Di Vita, G., Chinnici, G., Pappalardo, G., & D'Amico, M.** (2020). The Role of Credence Attributes in Consumer Choices of Sustainable Fish Products: A Review. In *Sustainability* (Vol. 12, Issue 23). https://doi.org/10.3390/su122310008

**Menozzi, D., Nguyen, T. T., Sogari, G., Taskov, D., Lucas, S., Castro-Rial, J. L. S., & Mora, C.** (2020). Consumers' preferences and willingness to pay for fish products with health and environmental labels: Evidence from five european countries. *Nutrients*, *12*(9), 1–22. https://doi.org/https://doi.org/10.3390/nu12092650

**Menozzi, D., Wongprawmas, R., Sogari, G., Gai, F., Parisi, G., & Mora, C.** (2023). The role of objective and subjective knowledge on the attitude and intention of Italian consumers to purchase farmed and wild fish. *Agricultural and Food Economics*, *11*(1), 1–25. https://doi.org/10.1186/s40100-023-00288-1

**Nunnaly, C.** (1978). Psychometric Theory. Mcgraw-Hill College.

**Pieniak, Z., Verbeke, W., Scholderer, J., Brunsø, K., & Olsen, S. O.** (2007). European consumers' use of and trust in information sources about fish. *Food Quality and Preference*, *18*(8), 1050–1063. https://doi.org/https://doi.org/10.1016/j.foodqual.2007.05.001

**Pieniak, Z., Verbeke, W., Scholderer, J., Brunsø, K., & Olsen, S. O.** (2008). Impact of consumers' health beliefs, health involvement and risk perception on fish consumption: A study in five European countries. *British Food Journal*, *110*(9), 898–915. https://doi.org/https://doi.org/10.1108/00070700810900602

**Pieniak, Z., Vanhonacker, F., & Verbeke, W.** (2013). Consumer knowledge and use of information about fish and aquaculture. *Food Policy*, *40*, 25–30. https://doi.org/https://doi.org/10.1016/j.foodpol.2013.01.005

**Salladarré, F., Guillotreau, P., Perraudeau, Y., & Monfort, M. C.** (2010). The demand for seafood eco-labels in France. *Journal of Agricultural and Food Industrial Organization*, *8*(1). https://doi.org/10.2202/1542-

0485.1308

**Salladarré, F., Brécard, D., Lucas, S., & Ollivier, P.** (2016). Are French consumers ready to pay a premium for eco-labeled seafood products? A contingent valuation estimation with heterogeneous anchoring. *Agricultural Economics*, *47*(2), 247–258. https://doi.org/https://doi.org/10.1111/agec.12226

**Schwartz, S. H.** (2012). An Overview of the Schwartz Theory of Basic Values. *Online Readings in Psychology and Culture*, *2*(1), 1–20. https://doi.org/10.9707/2307-0919.1116

**Sirieix, L., Delanchy, M., Remaud, H., Zepeda, L., & Gurviez, P.** (2013). Consumers' perceptions of individual and combined sustainable food labels: A UK pilot investigation. *International Journal of Consumer Studies*, *37*(2), 143–151. https://doi.org/https://doi.org/10.1111/j.1470-6431.2012.01109.x

**Sogn-Grundvåg, G., Larsen, T. A., & Young, J. A.** (2014). Product Differentiation with Credence Attributes and Private Labels: The Case of Whitefish in UK Supermarkets. *Journal of Agricultural Economics*, *65*(2), 368–382. https://doi.org/https://doi.org/10.1111/1477-9552.12047

**Sonntag, W. I., Lemken, D., Spiller, A., & Schulze, M.** (2023). Welcome to the (label) jungle? Analyzing how consumers deal with intra-sustainability label trade-offs on food. *Food Quality and Preference*, *104*(October 2022). https://doi.org/10.1016/j.foodqual.2022.104746

**Tagbata, D., & Sirieix, L.** (2010). L'équitable, le bio et le goût. Quels sont les effets de la double labellisation bio-équitable sur le consentement à payer de consommateurs ? *Cahiers Agricultures*, *19*(s1), 34–40. https://doi.org/https://doi.org/10.1684/agr.2009.0371

**Tversky, A., & Kahneman, D.** (1974). Judgment under Uncertainty: Heuristics and Biases. *Science*, *185*(4157), 1124–1131. http://www.jstor.org/stable/1738360

**Uchida, H., Onozaka, Y., Morita, T., & Managi, S.** (2014). Demand for ecolabeled seafood in the Japanese market: A conjoint analysis of the impact of information and interaction with other labels. *Food Policy*, *44*, 68–76. https://doi.org/10.1016/j.foodpol.2013.10.002

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

**Verbeke, W., Sioen, I., Brunsø, K., Henauw, S., & Camp, J.** (2007b). Consumer perception versus scientific evidence of farmed and wild fish: Exploratory insights from Belgium. *Aquaculture International*, *15*(2), 121–136. https://doi.org/10.1007/s10499-007-9072-7

**Weinstein, N. D.** (1988). The precaution adoption process. *Health Psychology*, *7*(4), 355–386. https://doi.org/10.1037//0278-6133.7.4.355

**Wessells, C. R., Johnston, R. J., & Donath, H.** (1999). Assessing Consumer Preferences for Ecolabeled Seafood: The Influence of Species, Certifier, and Household Attributes. *American Journal of Agricultural Economics*, *81*(5), 1084–1089. https://doi.org/https://doi.org/10.2307/1244088

**Whitehead, J. C.** (2002). Incentive Incompatibility and Starting-Point Bias in Iterative Valuation Questions. *Land Economics*, *78*(2), 285–297. https://doi.org/https://doi.org/10.2307/3147274

**Young, W., Hwang, K., McDonald, S., & J Oates, C.** (2010). Sustainable consumption: green consumer behaviour when purchasing products. *Sustainable Development*, *18*(March 2009), 20–31. http://dx.doi.org/10.1002/sd.394

**Zander, K., & Feucht, Y.** (2018). Consumers' Willingness to Pay for Sustainable Seafood Made in Europe. *Journal of International Food and Agribusiness Marketing*, *30*(3), 251–275. https://doi.org/https://doi.org/10.1080/08974438.2017.1413611

# Chapter 4: Consumers' place in territorial knowledge dynamics: the case of seafood products

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**Abstract**

This article proposes an interpretation of the concept of territorial dynamics of knowledge by integrating consumers into the industry-research-administration triptych in the case of the Fishery and Aquaculture Products (FAP) industry. Recent models involving consumers and producers are part of the knowledge and innovation economy. The article is motivated by two questions: Does the FAP industry meet the characteristics of knowledge-based economies? Is this knowledge shared with consumers? While disruptive innovations are rare, incremental improvements are frequent in this industry. This article is based on a consumer survey carried out in 2021 on the French market. The survey results, where consumers are separated according to their department of residence (coastal and non-coastal), support the hypothesis that geographical proximity strongly impacts knowledge of FAPs. Indeed, the results reveal that coastal households tend to have differentiated preferences for FAPs compared to non-coastal households. They pay more attention to the provenance (local and national) and the environmental impact of the FAPs they consume. An explicit difference in knowledge between coastal and non-coastal consumers can explain this difference in expressed preferences. Indeed, our results show that coastal consumers tend to have a higher level of subjective and objective knowledge regarding the FAP sector than non-coastal consumers. They tend to rate themselves as more expert, reflected in a greater knowledge of labelling regulations and the link between wild fisheries and aquaculture production. Based on these results, the discussion focuses on two issues: the environmental impact of fishing methods and trade regulations. While coastal households have a better knowledge of these two subjects, controversy is present.

**Keywords**: Consumers ; geographical proximity ; knowledge ; seafood products.

**Classification JEL**: D12, Q22, R11

## 4.1 - Introduction

By limiting the territorial dynamics of knowledge to the actors involved in production, valorisation and support administrations, we ignore the models of interaction between producers and consumers. Crevoisier (2011) identifies this weakness in work devoted to the territorial dynamics of knowledge[33]. Research conducted within the framework of geographical economics points to the absence of the consumer, especially in the case of product innovation. Von Hippel (1978) was one of the first to focus on the relationship between consumers and producers. However, studies that give consumers an active role are still scarce, particularly in industries that are less concerned with breakthrough innovations (Schumpeter, 1939; Dosi, 1982), such as the FAP industry.

The objective of this article is to compare the FAP industry, which is perceived as being far removed from the knowledge and innovation dynamics, with an approach that integrates the consumer in a territorial knowledge dynamic. Another particularity of the FAP industry is that the production sites are mainly located on the coast. Consequently, it can be hypothesised that geographical proximity is an ally in producer-consumer relations in coastal regions. For consumers in non-coastal regions, access to knowledge appears more challenging due to their distance from port sites. Their active participation in a territorial knowledge dynamic is less evident. However, it is important to consider the potential for resistance to consumption standards encouraged by the use of digital technology. This is one of the foundations of organised proximity, particularly among younger generations or *digital natives* (Prensky, 2001). Consequently, the greater prevalence of *digital natives* in non-coastal regions may influence the territorial dynamics of knowledge in the absence of geographical proximity. This hypothesis remains fragile, as shown by studies on consumer resistance behaviour (Le Roux and Thébault, 2018).

Based on the literature that originates in the article by Von Hippel (1978), we consider that the consumer has a full place in the territorial dynamics of knowledge. This article focuses on the knowledge related to FAPs. The territorial concept, the second key term in the study of territorial knowledge dynamics, is investigated by distinguishing between consumers located close to production sites and those located at a greater distance. The problem is formulated in two stages. First, it is necessary to determine whether the FAP industry meets the characteristics of knowledge-based economies? Second, it is important to ascertain whether this knowledge is shared with consumers?

Section 2 presents a review of the literature on interaction models between producers and consumers. The absence of the consumer in the territorial dynamics of knowledge is historically linked to the choice of a linear model from upstream to downstream. We draw on recent work on the rehabilitation of the consumer in the value chain.

[33] TIMs (Territorial Innovation Models) were profoundly influenced by the industrial economy, with a primary focus on production and innovation systems. Contemporary production and consumption are significantly more complex, encompassing media and direct social interactions, and incorporating a greater cultural dimension. It is therefore essential to consider the intricate dynamics of production and consumption networks, including their territorial organization (p. 3).

Section 3 provide answers to the first question of the problematic by specifying the nature of the knowledge produced by the FAP industry. Disruptive innovations are rare, although several works show that significant technological changes have affected the trajectories of fishing fleets (Le Floch *et al.*, 2023) or redirected consumers towards new forms of marketing (Salladarré *et al.*, 2018).

Section 4 presents the data and methods used to empirically assess the relationship between area of residence, knowledge and consumption behaviour. This empirical analysis is based on the findings of a consumer survey conducted in 2021 among French FAPs consumers. The methodology employed is based on two means comparison tests and a multinomial logit model with marginal effects.

Section 5 presents the results of a first means comparison test between our two subsamples regarding their preferences for FAPs. The results of a multinomial logit model are then discussed. Finally, the results of a second means comparison test are presented based on the level of knowledge.

Section 6 of this paper focuses on the concept of knowledge produced by actors in the FAP industry. This concept is at the centre of the discussion, mainly based on the results of means comparison tests on consumer preferences for FAPs and knowledge.

The conclusion proposes perspectives for future research on integrating consumers in territorial knowledge networks, particularly for activities involving the exploitation of living marine resources.

## 4.2 - Literature review on interaction models between producers and consumers

The concept of the territorial dynamics of knowledge, initially conceived in the context of innovative milieus (Maillat, 1995; Maillat and Kebir, 1999), is used in this study. The dissemination of knowledge to the stakeholders of a production system is linked to a territorial dynamic. The classical knowledge transfer and appropriation forms are innovation clusters (Forest and Serrate, 2011). In France, competitiveness clusters are a concrete form of innovation clusters (Chalaye and Massard, 2009). They facilitate the creation of networks bringing together local actors from industry, research and development, and support services. The lack of consideration of the role of the consumer in these dynamics, as highlighted by Crevoisier and Jeannerat (2009) and Crevoisier (2011), builds on earlier work on interaction models, in particular Grabher, Ibert and Flohr (2008), further developed by Jeannerat and Kebir (2015) and more recently Martin, Martin and Zukauskaite (2019).

Grabher, Ibert and Flohr (2008) propose a typology of models of interactions between producers and consumers (Figure 4.1). The authors do not exclude the traditional model in which consumers are simply "order takers" – the deductive model – but extend the framework of analysis to an inductive model – the consumer is

"order giver" – and above all to a co-development model – the hybrid model.

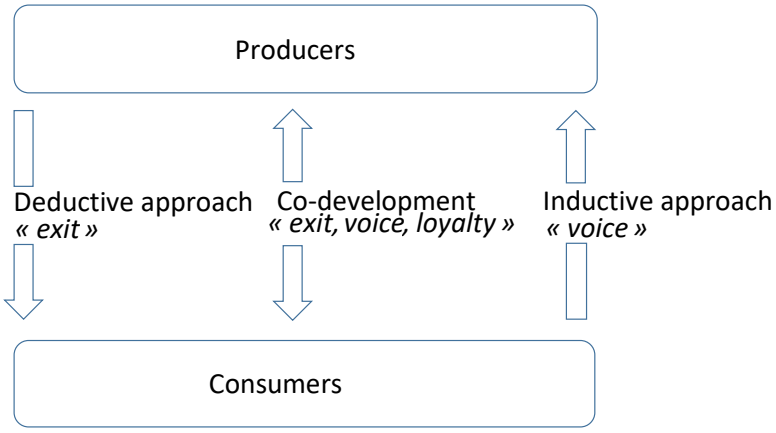


**Figure 4.1 - Producer and consumer interaction models**
Source – According to Grabher, Ibert and Flohr (2008)

With regard to the co-development model, Grabher, Ibert and Flohr (2008) draw on examples conceived in the digital world (free software, video games, web2.0), while the others come from the design of "cycle products", medical equipment and body care. The examples selected belong to universes where the dynamic of growth is constantly fuelled by innovation. This is not necessarily the case in the FAP industry, despite the emergence of new products and processes on a more regular basis, partly due to the marine biotechnologies (Rotter *et al.*, 2021) and the influence of consumers (Brécard *et al.*, 2009; Brécard *et al.*, 2012).

Jeannerat and Kebir (2015) describe the territorial dynamics of knowledge in a sequential framework. The territorial model of innovation, which associates two sequences - that of the production and reproduction of knowledge in the production system - is linked to a third sequence, that of the consumption system. It is through the market that consumers become part of the territorial knowledge dynamic, with an interest or lack of interest in the products available (Figure 4.2).

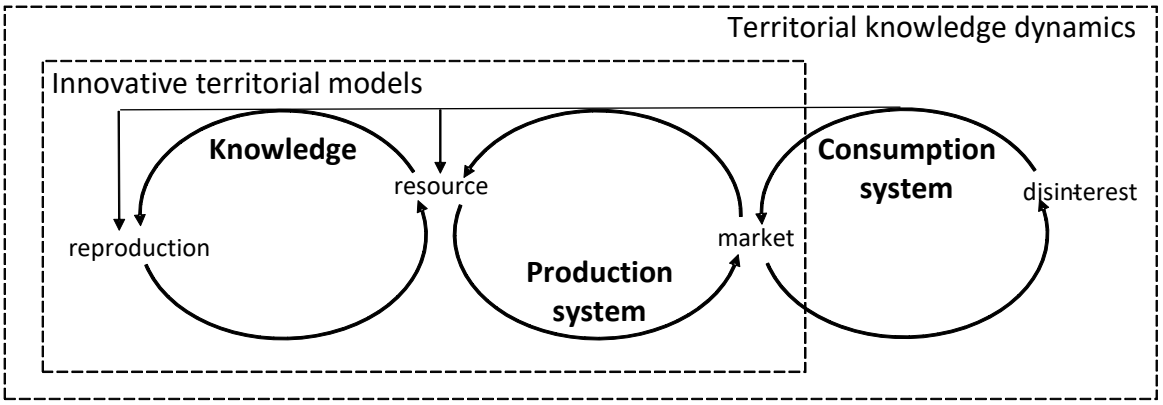


**Figure 4.2 - Territorial knowledge dynamics and innovative territorial models**
Source - adapted from Jeannerat and Kébir, 2015

This scheme is analogous to the first two models of Grabher, Ibert and Flohr (2008), in which consumers express themselves by rejecting the product (exit) in the deductive approach (the consumer is the order taker) or

by requesting product modification (voice) in the inductive approach (the consumer is the order giver).

Building on this model, Jeannerat and Kebir (2015) propose a reading of the choice of knowledge. The first is technological. A major upstream innovation in an industry gives the market a new direction. Resistance organised by consumer or environmental protection associations may emerge, notably in the face of new food systems driven by biotechnology. This phenomenon is exemplified in the FAP industry, particularly in aquaculture. The farmed salmon sector has raised concerns among consumers (Aerni, 2004). In the second reading, knowledge is presented as an improvement to the established economic system. In the third reading, a reference to FAPs is plausible between a new and an old technology. It is about knowledge leading to an adaptation of the economic system. We find biotechnologies crossed with agri-food systems. This reading is an interpretation of a model by Pistorius and Utterback (1997) called *symbiosis*, which combines an emerging technology with a mature technology. The fourth reading concerns co-development within a hybrid community, partly located on the production site or at a distance. We find the intermediate model of Grabher, Ibert and Flohr (2008), between deductive and inductive approaches.

Martin, Martin and Zukauskaite. (2019) provide an interpretation of the path of regional development. It is also through disruptive or radical innovation that a new production system is formed (*path upgrading*). Incremental innovation updates the scientific and technical knowledge of the existing production system by extending the path (*path extension*), which can also disappear due to resource depletion (*path exhaustion*). The third path (*path diversification*) can combine an old and a new industry, using the example of agri-food systems and biotechnologies, or bring together two distinct activities, such as fishing and tourism. Martin, Martin, and Zukauskaite (2019) add two other paths: the importation of activities (*path importation*) and, more rarely, a technological paradigm shift leading to the creation of a new economic system (*path creation*). In essence, demand analysis offers a more comprehensive insight into the regional economic system. Consumer behaviour can influence the viability of a production method, either by modifying it or by rendering it obsolete.

FAPs are no exception to the influence of demand on the choice of fishing techniques, types of packaging and distribution. A convincing illustration of this phenomenon can be observed in the analysis of French household consumption patterns during the years of the COVID crisis, spanning from 2017 to 2021 (Heutte *et al.,* 2023). Imported farmed salmon and imported wild cod were preferred to domestic products. Attributes of a better environmental footprint (small-scale fishing) or proximity channels (local fishing) were unable to compete with the preference for pre-packed imported products sold in supermarkets. This example illustrates that consumers, whose well-being was negatively affected by the health crisis, did not heed the calls of local professionals to increase local consumption (Alban *et al.,* 2022a). The first examples drawn from the FAP industry in this literature review demonstrate that innovation is not lacking (satellite tracking, introduction of artificial intelligence, attributes of proximity or small environmental footprint). However, it is important to recognise that the production of knowledge follows the same technological trajectories (Le Floc'h and Fuchs,

2001).

## 4.3 - Does the FAP industry meet the characteristics of knowledge-based economies?

Often compared to agriculture, the FAP industry is no exception to the dynamics of knowledge transfer and appropriation in a given territory. The networking of sea fishing and aquaculture operators, even though these two sectors have their own operating logic, is organised at two levels. At the national scale, there is a common system for the entire coastal territory, with FranceAgriMer (https://www.franceagrimer.fr/) disseminating knowledge on the state of the markets and IFREMER (https://www.ifremer.fr/fr) working on research and innovation missions. However, at the regional or infra-regional level, based on local production systems, it becomes evident that the territorial dynamics of knowledge are not homogeneous. This is illustrated by the restrictions imposed during the Covid19 pandemic in 2020, which had a differentiated impact on territories dependent on the exploitation of FAPs (Alban *et al.*, 2022a).

Consumers living mainly in coastal areas have immediate access, through geographical proximity, to local FAP production systems built around a fishing port or shellfish basin (Figure 4.3). The quantity and quality of information received by coastal residents on the state of marine resources reinforces this geographical proximity.

The national network includes 34 fish markets. Aquaculture is represented by observation sites, including two on the Channel coast, five in the Atlantic and one in the Mediterranean. Mussel and oyster farming represent the majority of French aquaculture production, while fish farming is less important. It is around these local production systems that territorial knowledge dynamics are created. The concept is rooted in the knowledge economy on the one hand and territorial dynamics on the other.

The FAP industry, which is concentrated in rural and coastal areas, provides numerous examples of technical change. It is true that technological breakthroughs are less frequent than in high-tech sectors. However, it is mainly the adaptations of production methods, which can be defined as incremental innovation (Freeman, 1991), that renew expertise. Codified knowledge, which can be transmitted at a low cost and is immediately available, is provided by national marine science research institutes (Van Wyk and Wessels, 1987; Le Floc'h and Fuchs, 2001; Eigaard, 2009). While it is accepted that the seafood industry is part of a knowledge-based economy, adapted to a slow cycle of innovation, the most widespread form in sea-related areas is tacit rather than codified.

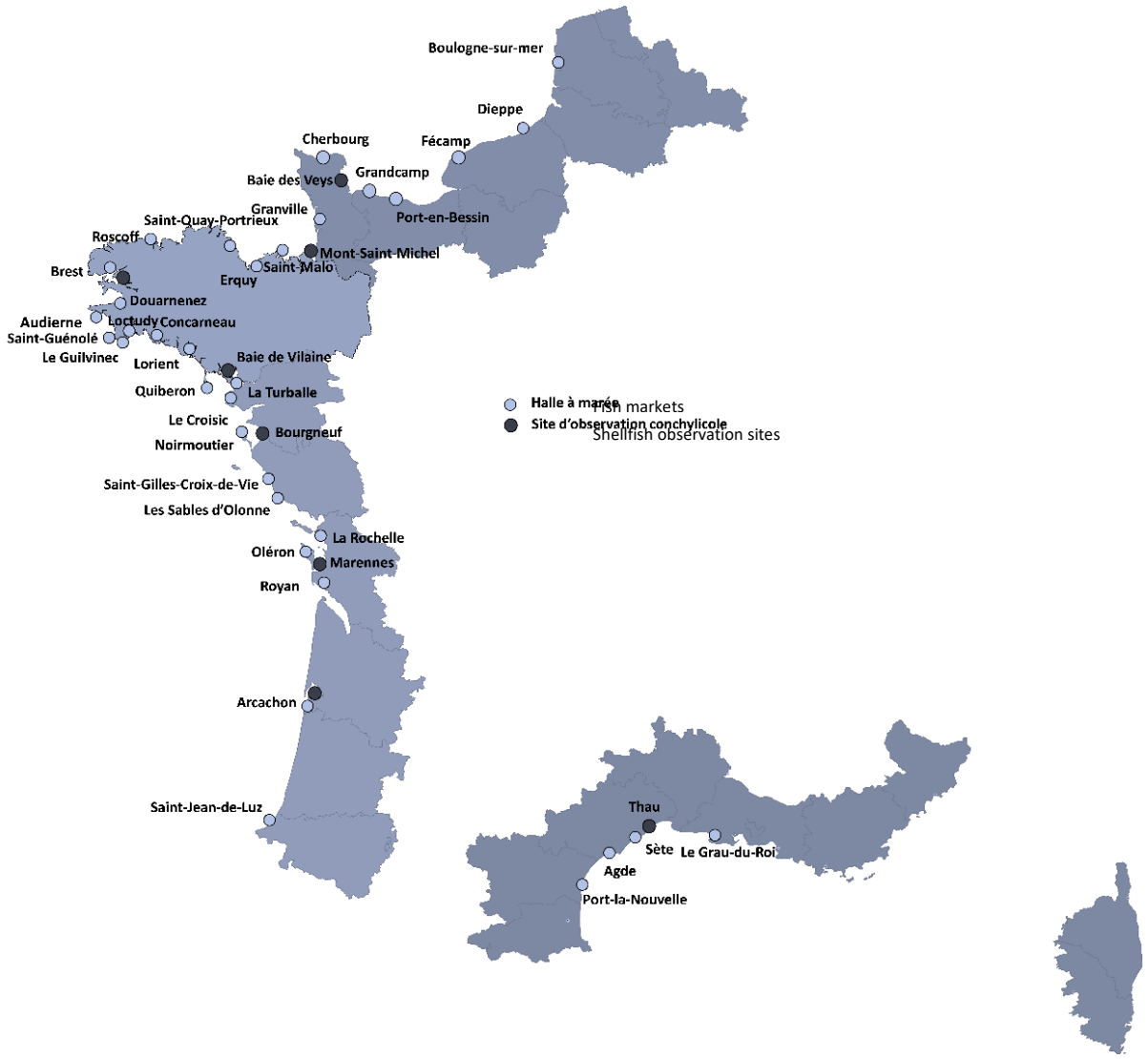


**Figure 4.3 - Network of French fish markets and shellfish observation sites**
Source - Alban *et al.* (2022b) for the fish markets network, IFREMER for the shellfish observation sites

At the territorial level, tacit knowledge is transmitted between seafarers in the form of expertise (Whitmarsh *et al.*, 1995; Valdemarsen, 2001; Sverrisson, 2002; Gordon and Hannesson, 2015). Tacit knowledge is individual approach and based on experience. It is much more complex to disseminate and share, especially beyond a territory immersed in a specific industrial atmosphere.

Those who live close to the production sites mentioned above play a key role in the dissemination of tacit knowledge, mainly through the family environment or the presence of local media. Their contributions are mainly focused on knowledge appropriation, with less frequent cases of transformation and creation (Figure 4.4). This appropriation depends on the geographical proximity of the production sites, which are sometimes complemented

by interpretation centres for maritime professions.

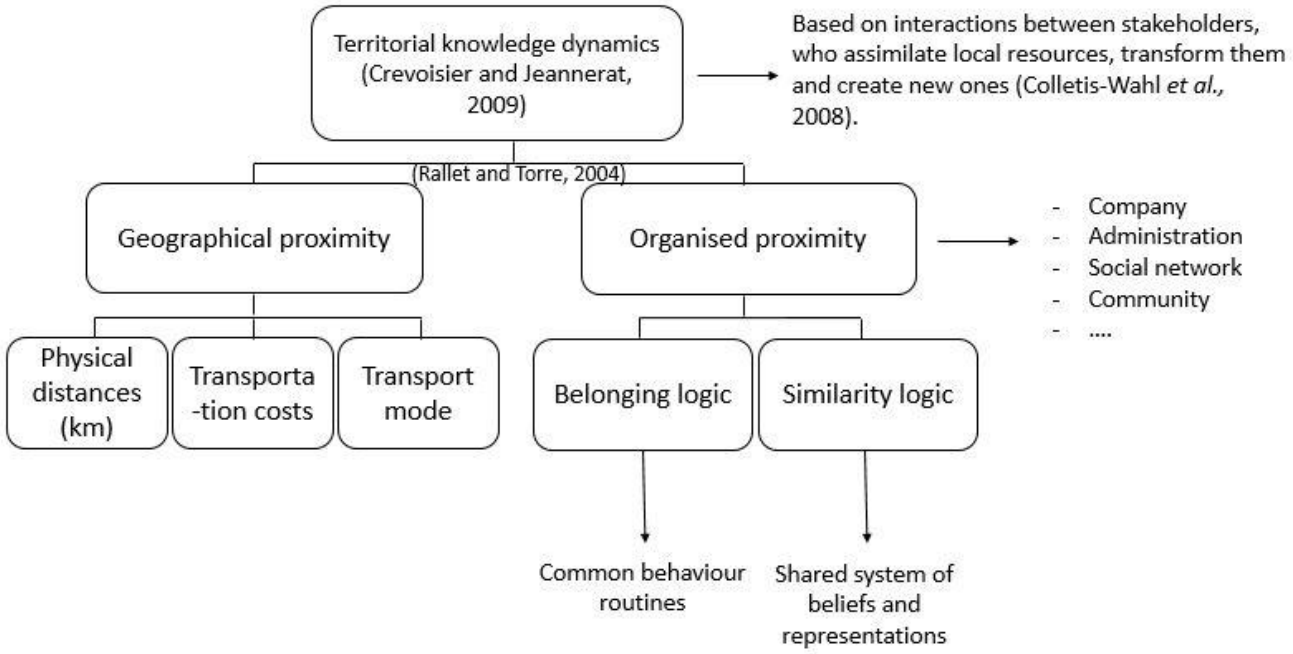


**Figure 4.4 - Territorial knowledge dynamics**
Source - Authors' elaboration according to Torre *et al.* (1992) and Colletis-Wahl *et al.* (2008)

This model forms the basis for testing the hypothesis of territorial dynamics of knowledge between two samples of consumers – one coastal, the other non-coastal.

## 4.4 - Data and methods

In order to determine the influence of geographical location on consumer awareness of the FAP industry, our analysis is based on a consumer survey conducted in metropolitan France in 2021. The total sample was divided into two sub-samples according to the département of residence. The first sub-sample consists of coastal households, and the second of non-coastal households.

### 4.4.1 - Data

The database used in this article comes from a FAP consumption survey performed by KantarWorldPanel. The survey was conducted online in April 2021 among a panel of French households that consume FAPs. The survey is part of two research projects: a French COPECO project[34] (Alban *et al.*, 2022a,b) and a Norwegian project funded by the Norwegian Research Council[35]. The objective of these two projects is to assess the impact of the COVID-19 crisis on the consumption of FAPs and to measure French consumers' preferences for labelled products. The survey was conducted in the context of public health measures implemented in response to the global pandemic (COVID-19). This crisis had a significant impact on the French industrial sector, particularly in terms of production (Alban *et al.*, 2022b). However, the impact on consumption was much more limited.

[34] Find out more about this research programme: https://www.umr-amure.fr/projets-scientifiques/projet_copeco/
[35] Find out more about this research programme: https://www.forskningsradet.no/en/

Domestic production did not benefit significantly from the promotional activities of the French industry, as consumers demonstrated a preference for imported products (Heutte *et al.*, 2023).

The initial analysis sample consists of 1,503 respondents, who are representative of the French population in terms of age and gender, selected using the quota method. After dealing with incomplete responses, non-responses and inconsistencies in responses, the final analysis sample is based on 1,233 respondents. Table 4.1 presents the characteristics of this sample.

**Table 4.1 - Sample characteristics (n = 1 233)**

| | Sample | | France[1] | |
|---|---|---|---|---|
| **Gender (%)** | Male | Female | Male | Female |
| | 49 | 51 | 48 | 52 |
| **Socio-professional categories (%)** | | | | |
| Farmers | 0,2 | | 0,8 | |
| Craftsmen, shopkeepers and company directors | 2,7 | | 3,5 | |
| Managers and higher intellectual professions | 12,0 | | 9,5 | |
| Intermediate Professions | 14,2 | | 14,1 | |
| Employees | 26,7 | | 16,1 | |
| Workers | 4,7 | | 12,1 | |
| Retired | 28,6 | | 26,9 | |
| Other non-working people | 10,8 | | 17,0 | |
| **Age categories (%)** | | | | |
| 18 - 34 | 22,6 | | 22,6 | |
| 35 - 49 | 25,1 | | 24,9 | |
| 50 - 64 | 26,8 | | 25,2 | |
| 65 + | 25,6 | | 27,2 | |

Source - COPECO/RCN survey – 2021
[1] INSEE, data from 2021

We wanted to measure the influence of our consumers' characteristics on their preferences for labelled FAPs. Consumers were asked to rank their three favourite labels from a range of alternatives. Table 4.2 shows the labels suggested to consumers. It is important to note that individuals were given the option of choosing an unlabelled FAP. The suggested labels are hypothetical labels and do not refer to existing labels.

**Table 4.2 - Defintion of labels presented in the survey**

| Labels | Definition |
|---|---|
| Local origin | Label identifying a regional FAP |
| France origin | Label identifying a French FAP (outside the region) |
| EU origin | Label identifying a FAP from European (outside France) |
| Fair-Trade | Label identifying a fair trade FAP |
| Ecolabel | Label identifying FAPs produced with respect for the environment and resources |
| Quality | Label identifying a high quality FAP |
| Safety | Claim identifying a FAP free of toxic substances |
| Nutrition | Claim identifying a FAP rich in nutrients (Omega 3) |
| Animal Welfare | Label identifying a FAP that respects animal welfare |

Source - COPECO/RCN survey – 2021

Place of residence is linked to whether the département is close to the sea (coastal sample) or far from the sea (non-coastal sample). One-third of the sample (36%) lives in coastal départements and two-thirds (64%) live in non-coastal départements.

**Table 4.3 - Sample distribution by age and place of residence**

| | **Coastal** | | | **Non-coastal** | | | **Global** | | |
|---|---|---|---|---|---|---|---|---|---|
| | Female | Male | Total | Female | Male | Total | Female | Male | Total |
| **Total** | 52 % | 48 % | 439 | 51 % | 49 % | 794 | 52 % | 48 % | 1233 |

Source - COPECO/RCN survey - 2021

### 4.4.2 - Methods

#### 4.4.2.1 - Multinomial Logit Model with marginal effects

The statistical method used to study the preferences expressed for labelled FAPs is the multinomial logit model (MLM) with marginal effects. This model has been described in the literature as suitable for representing economic choice situations, especially with regard to consumer preferences (McFadden and Train, 2000; Hosmer *et al.*, 2013; Greene, 2018).

This is a random utility model (MacFadden, 1974). Consumers compare the available alternatives and rank them according to the utility they provide. The utility $U$ received by individual $i$ with respect to alternative $j$ is therefore written as:

$$U_{ij} = z'_{ij}\theta + \varepsilon_{ij} \quad (1)$$

The utility obtained by consumer *i* through alternative j depends on his characteristics and those of alternative *j*, represented here by *z'*. If the consumer chooses alternative *j* from among the *J* alternatives (ten possibilities here), then :

$$Prob(U_{ij} > U_{ik}) \text{ for all } k \neq j \quad (2)$$

Let $Y_i$ be a random variable representating the respondents' choice among the ten alternatives, $w_i$ is a vector of characteristics of individual *i* and $\alpha_j$ a vector of characteristics associated with the available alternatives. According to Greene (2018), we obtain :

$$Prob\ (Y_i|j = w_i) = P_{ij} = \frac{\exp\ (w'_i\alpha_j)}{\sum_{j=0}^{10} \exp\ (w'_i\alpha_j)} = 0, 1, \ldots, 10 \quad (3)$$

The results from the MLM model are difficult to interpret in their primary form. The results presented in this article are marginal effects, as they allow a better understanding and interpretation of the results provided.

Finally, the model includes 22 explanatory variables. These variables were selected based on the literature on consumer preferences for labelled FAPs (Brécard *et al.*, 2009; Brécard *et al.*, 2012; Salladarré *et al.*, 2010; Zander and Feucht, 2018; Menozzi *et al.*, 2020). The first eight variables (*Fresh; Wild; Local; Environment; France; Farming; Risk; EU*) express consumer preferences for FAPs. Four variables are related to consumer knowledge (*Subjective; Objective; Label; Specific*). In addition, four age groups were included in the model (*[18-34]; [35-49]; [50-64; [65+]*), two gender variables (*female-male)* and four variables related to the place of purchase of FAPs (*supermarkets*, *direct sales*, *fishmongers*, *specialised shops*). Appendix 5.A1 provides details of all explanatory variables used in the model.

4.4.2.2 - Variance and means-comparison tests

In order to test for the existence of significant differences between our two samples (firstly in terms of preferences for FAPs and secondly in terms of knowledge of the FAP industry), two statistical tests were used: a comparison of variances test and a comparison of means test. The comparison of variances test allows us to select the most relevant comparison of means test based on the variance of the data being compared. According to (Overall *et al.*, 1995), if the two variances are unequal, Welch's t-test provides a more accurate estimate of the difference between the means. Otherwise, Student's t-test is used. For these tests of comparison of means, the H0 hypothesis is that the means of the two samples are equal. If the p-value obtained is less than 5%, the H0 hypothesis is rejected and the alternative hypothesis Ha can be accepted, i.e. that the two means are statistically different between the two samples.

## 4.5 - Results

Individuals were asked to rate their preferences for FAPs on a scale from 0 (strongly disagree) to 10 (strongly agree) (Table 4.4). Consumers in coastal areas differed from those in non-coastal areas on three preferences. The regional and national origin of FAPs is more important for coastal households. Indeed, the mean for these households is higher than for non-coastal households. Environmental impact is also highlighted as an important preference specific to the coastal population. On the other hand, the preferences expressed for fresh products, for farmed species, for wild species and for EU origin do not differ between the two samples.

**Table 4.4 - Results of t-tests on preferences for FAPs**

| Preferences | p-value | Hypothesis retained | Mean Coastal | Mean Non-Coastal |
|---|---|---|---|---|
| I buy fresh fish (whole or sliced) rather than canned, processed or frozen. | 0,09 | H0 | 7.30 | 7.07 |
| It's important to me to buy wild fish | 0,67 | H0 | 6.61 | 6.56 |
| *It's important for me to know that my fish comes from my region* | *0,00* | *Ha* | *6.77* | *5.71* |
| *It's important for me to know that my fish comes from France* | *0,03* | *Ha* | *7.14* | *6.85* |
| *I buy fish whose production method has a low environmental impact* | *0,00* | *Ha* | *6.40* | *6.00* |
| It's important for me to buy farmed fish | 0,75 | H0 | 4.91 | 4.96 |
| I buy fish that does not present a health risk | 0,48 | H0 | 6.15 | 6.05 |
| It's important for me to know that my fish comes from Europe | 0,23 | H0 | 6.81 | 6.65 |

Source - COPECO/RCN survey – 2021

The territorial dimension seems to be a marker for coastal households, in particular, with a preference for the regional FAP. The greater awareness of low environmental impact production methods indicates knowledge and interest in production techniques. However, the issue of the impact of fishing techniques on the ecosystem remains highly controversial in the fishing industry.

Tables 4.5, 4.6 and 4.7 present the results of the MLM model. Only the results for the labels “local origin” (Table 4.5), “France origin” (Table 4.6) and “ecolabel” (Table 4.7) are discussed. In fact, it is the three labels related to preferences that distinguish the two samples in the results presented in Table 4.4.

The preference for local FAPs and the associated label are positively correlated for both sub-samples. This relationship is stronger for coastal consumers (+5.3%) than for non-coastal consumers (+1.6%). Ecolabels are less preferred by consumers who are attached to the local origin of their FAPs (-2.1% in coastal areas and -1.6% in non-coastal areas). This result may be surprising in view of our means comparison test, which suggests that coastal households have a stronger preference for low environmental impact technologies.

**Table 4.5 - Results of the multinomial logit model with marginal effects (Local origin)**

| | **Local** | | | |
|---|---|---|---|---|
| | Coastal | | Non-Coastal | |
| Nb of individuals | 190 | | 170 | |
| | Coef. | Std err. | Coef. | Std err. |
| **Preferences** | | | | |
| Fresh | 0,013 | 0,010 | 0,001 | 0,005 |
| Wild | -0,028*** | 0,010 | 0,007 | 0,006 |
| Local | 0,053*** | 0,015 | 0,016*** | 0,006 |
| Environment | 0,003 | 0,011 | -0,006 | 0,005 |
| France | 0,007 | 0,015 | 0,016** | 0,007 |
| Farmed | 0,015** | 0,007 | -0,001 | 0,004 |
| Health risk | 0,005 | 0,009 | -0,011** | 0,005 |
| EU | -0,025** | 0,012 | -0,013** | 0,006 |
| **Knowledge** | | | | |
| Subj. | -0,019 | 0,018 | 0,006 | 0,009 |
| Obj. | 0,011* | 0,017 | 0,012 | 0,009 |
| Label | -0,008 | 0,012 | -0,006 | 0,007 |
| Specific | 0,041 | 0,047 | -0,070 | 0,043 |
| **Age (reference + 65 years old)** | | | | |
| [50-64] | -0,055 | 0,044 | 0,033 | 0,026 |
| [35-49] | -0,086* | 0,050 | 0,009 | 0,028 |
| [18-34] | -0,001 | 0,052 | 0,001 | 0,031 |
| **Male** | 0,066* | 0,036 | -0,036* | 0,020 |
| **Distribution channels** | | | | |
| Supermarkets | -0,183 | 3,929 | 0,012 | 0,046 |
| Direct sales | 0,045 | 0,039 | -0,004 | 0,021 |
| Specialised shops | -0,034 | 0,041 | 0,004 | 0,022 |
| Fishmongers | -0,009 | 0,046 | 0,027 | 0,025 |

Source - COPECO/RCN survey - 2021

*Note: Significance thresholds : *** 0,01 ; ** 0,05 ; * 0,10*

**Table 4.6 - Results of the multinomial logit model with marginal effects (France origin)**

| | France | | | |
|---|---|---|---|---|
| | Coastal | | Non-Coastal | |
| Nb of individuals | 340 | | 200 | |
| | Coef. | Std err. | Coef. | Std err. |
| **Preferences** | | | | |
| Fresh | 0,003 | 0,008 | -0,025*** | 0,007 |
| Wild | 0,021* | 0,011 | -0,001 | 0,008 |
| Local | 0,020 | 0,013 | 0,005 | 0,007 |
| Environment | -0,027*** | 0,010 | -0,017** | 0,008 |
| France | 0,010 | 0,014 | 0,039*** | 0,010 |
| Farmed | 0,007 | 0,007 | 0,003 | 0,006 |
| Health risk | -0,003 | 0,009 | 0,001 | 0,007 |
| EU | -0,004 | 0,012 | 0,009 | 0,009 |
| **Knowledge** | | | | |
| Subj. | -0,004 | 0,016 | 0,013 | 0,013 |
| Obj. | -0,012 | 0,017 | 0,014 | 0,013 |
| Label | -0,003 | 0,012 | -0,004 | 0,010 |
| Specific | 0,060 | 0,045 | 0,049 | 0,039 |
| **Age (reference + 65 years old)** | | | | |
| [50-64] | -0,077* | 0,046 | -0,023 | 0,035 |
| [35-49] | -0,034 | 0,044 | -0,068** | 0,038 |
| [18-34] | -0,022 | 0,049 | -0,065 | 0,042 |
| **Male** | -0,043 | 0,035 | 0,022 | 0,028 |
| **Distribution channels** | | | | |
| Supermarkets | -0,196 | 3,827 | -0,021 | 0,056 |
| Direct sales | -0,091** | 0,037 | 0,008 | 0,029 |
| Specialised shops | 0,060 | 0,038 | 0,002 | 0,032 |
| Fishmongers | 0,000 | 0,040 | 0,002 | 0,033 |

Source - COPECO/RCN survey - 2021

*Note: Significance thresholds : *** 0,01 ; ** 0,05 ; * 0,10*

**Table 4.7 - Results of the multinomial logit model with marginal effects (Ecolabel)**

| | **Ecolabel** | | | |
|---|---|---|---|---|
| | Coastal | | Non-Coastal | |
| Nb of individuals | 146 | | 319 | |
| | Coef. | Std err. | Coef. | Std err. |
| **Preferences** | | | | |
| Fresh | 0,000 | 0,007 | 0,000 | 0,006 |
| Wild | -0,004 | 0,008 | -0,013* | 0,007 |
| Local | -0,021** | 0,009 | -0,016*** | 0,006 |
| Environment | 0,033*** | 0,009 | 0,037*** | 0,008 |
| France | -0,005 | 0,010 | -0,003 | 0,009 |
| Farmed | -0,014** | 0,005 | -0,008 | 0,006 |
| Health risk | -0,004 | 0,006 | -0,008 | 0,006 |
| EU | 0,003 | 0,010 | -0,001 | 0,008 |
| **Knowledge** | | | | |
| Subj. | -0,005 | 0,012 | 0,004 | 0,012 |
| Obj. | -0,010 | 0,012 | -0,013 | 0,012 |
| Label | -0,006 | 0,008 | 0,016** | 0,009 |
| Specific | -0,031 | 0,045 | 0,001 | 0,039 |
| **Age (reference + 65 years old)** | | | | |
| [50-64] | 0,026 | 0,053 | 0,031 | 0,035 |
| [35-49] | 0,097 | 0,048 | 0,030 | 0,037 |
| [18-34] | 0,146*** | 0,051 | 0,072* | 0,038 |
| **Male** | 0,044 | 0,031 | 0,037 | 0,025 |
| **Distribution channels** | | | | |
| Supermarkets | -0,066 | 2,357 | -0,120 | 0,041 |
| Direct sales | 0,005 | 0,031 | 0,019 | 0,026 |
| Specialised shops | 0,052* | 0,028 | -0,012 | 0,029 |
| Fishmongers | 0,012 | 0,034 | 0,008 | 0,029 |

Source - COPECO/RCN survey - 2021

*Note: Significance thresholds : *** 0,01 ; ** 0,05 ; * 0,10*

In coastal households, consumers who value the wild aspect of their FAPs look less for "local origin" labels (-2.8%) and more for "France origin" labels (+2.1%). For non-coastal households, we find a negative correlation between this preference and ecolabels (-1.3%). The same negative correlation is found for non-coastal households between the preference for a fresh product and "France origin" labels (-2.5%), as well as between the preference for a product without health risks and "local origin" labels (-1.1%). Finally, for coastal households, preference for a farmed product is positively correlated with local origin labels (+1.5%) and negatively correlated with ecolabels (-1.4%).

The preference for a French product has a positive influence on the preferences expressed for "local origin" (+1.6%) and "France origin" (+3.9%) labels among non-coastal households. Individuals who state that they "*buy fish whose production method has a low impact on the environment*" are logically more likely to prefer environmental labels (+3.3% for coastal households and +3.7% for non-coastal households). However, these same people are less likely to look for FAPs labelled "France origin" (-2.7% for coastal consumers and -1.7% for non-coastal consumers). These consumers do not associate a label guaranteeing the French origin of a FAP with environmental guarantees.

The results of the model show a significant age effect. Younger generations show a greater interest in ecolabelled FAPs than the over 65s, especially young people from coastal regions aged 18-34 (+14.6%). Although not negligible, the interest is half as high among young people from non-coastal regions (+7.2%). The results show that coastal people aged 35 to 49 are less interested in the "local origin" label (-8.6%), and coastal citizens aged 50 to 64 are less interested in the "France origin" label (-7.7%) than people aged 65 and over. For non-littoral households, people aged 35-49 have a lower preference (-6.8%) for the labels "France origin" than people aged 65 and over.

We also find a gender effect, with men in the coastal départements looking for the "local origin" label more than women (+6.6%), while the opposite relationship was observed for non-coastal households (-3.6%). The "distribution channel" effect is limited for the labels tested, with only two significant relationships (negative correlation between preference for "France origin" labels and the use of direct sales for coastal households (-9.1%); positive correlation for ecolabels and the use of specialist shops for coastal households (+5.2%).

The model remains disappointing when it comes to the notion of knowledge, which is central to understanding the role of consumers in a territorial knowledge dynamic. Two variables emerge from the analysis at the 10% level of significance. Coastal consumers with objective knowledge of the sector are slightly more likely (+1.1%) to look for FAPs labelled as "local origin". Non-coastal consumers who perceive labels as an effective information tool are more likely to look for ecolabels (+1.6%).

The concept of knowledge, which is often described in terms of a dual tacit and codified aspect in the literature on innovation diffusion models, is presented in the questionnaire in four areas: subjective knowledge,

objective knowledge, label knowledge and specific knowledge. Respondents were asked to position themselves on a scale ranging from 0 (I strongly disagree) to 7 (I strongly agree) for all questions relating to subjective knowledge and true, false or don't know for objective knowledge (Table 4.8).

Subjective knowledge is tacit knowledge, placing the respondent at the interface between appropriation ("*I know a lot*") and diffusion ("*consider myself an expert*"). The rejection of H0 on the first question ("*Compared to an average person, I know a lot about fish*") means that the two samples are unequal. It is particularly in coastal regions that consumers show a greater knowledge of FAPs.

Objective knowledge, assimilated to codified knowledge, is defined by four questions. There is no significant difference between our two samples in terms of knowledge of the link between fishing and aquaculture, nor of the link between production and small coastal boats. It is on the method of production (*The method of production...is not compulsory information on seafood sold fresh*) and the feed used for farmed fish (*Oils and meals from wild fish are used as feed for farmed fish*) that the responses follow separate trajectories. Coastal consumers are more likely to indicate that the first statement is false and the second is true. Indeed, since 2013, informing EU consumers about the catching technique (fishing) or the farming technique (aquaculture) has been compulsory.

**Table 4.8 - Results of t-tests on consumer knowledge**

| Questions | p-value | Assumption | Mean Coastal | Mean Non-Coastal |
|---|---|---|---|---|
| **Subjective knowledge** | | | | |
| *Compared to the average person, I know a lot about fish* | *0,02* | *Ha* | *3.73* | *3.52* |
| I do not know much about judging the quality of fish. | 0,39 | H0 | 3.62 | 3.70 |
| People who know me think of me as a fish expert. | 0,45 | H0 | 2.75 | 2.67 |
| I don't know much about preparing fish | 0,96 | H0 | 3.29 | 3.29 |
| **Objective knowledge** | | | | |
| Farmed products and aquaculture products mean the same thing | 0,88 | H0 | 0.49 | 0.50 |
| *The method of production (wild or farmed) is not mandatory for seafood sold fresh.* | *0,01* | *Ha* | *0.67* | *0.75* |
| *Oils and meal from wild fish are used as feed for farmed fish* | *0,05* | *Ha* | *0.86* | *0.81* |
| The majority of fish products marketed in France are landed by small-scale fisheries | 0,57 | H0 | 0.54 | 0.52 |
| **Label knowledge** | | | | |

| | | | | |
|---|---|---|---|---|
| Labelling is an effective way of informing consumers | 0,97 | H0 | 4.82 | 4.81 |
| **Specific knowledge** | | | | |
| In your opinion, what is the share of [farmed salmon] or [wild cod] in French consumption? | 0,36 | H0 | 0.13 | 0.11 |

Source - COPECO/RCN survey - 2021

## 4.6 - Discussion

Does the FAP industry have the characteristics of a knowledge-based economy? In the strict sense of territorial knowledge dynamics, based on the triptych of industrial actors, research and support administrations, the FAP industry can be presented as a knowledge-based economy. Technological breakthroughs are not absent among fishermen (Le Floc'h *et al.*, 2023), although they occur at long intervals over several decades. Incremental innovations are more frequent throughout the industry, especially in marketing methods to meet the expectations expressed by consumers, such as labels or short distribution channels (Brécard *et al.*, 2012; Le Velly and Dufeu, 2016; Lazuech and Debucquet, 2017; Zander and Feucht, 2018).

Can we say that this knowledge is shared with consumers? Several results confirm the influence of geographical proximity as a determining factor in transferring knowledge between producers and consumers in coastal areas. However, some of these results have not been spared from controversy, particularly the impact of fishing techniques on the ecosystems exploited. The discussion is based on the results of two means comparison tests supported by the logit model: preference for techniques with low environmental impact and better knowledge of trade regulations among coastal households. The discussion focuses, in particular, on the controversy surrounding the impact of fishing techniques.

Coastal consumers differ from other households in their preference for FAPs with a low environmental impact. Fishing techniques can be divided into two groups: towed (including trawling) and passive (traps, lines and nets set at sea). The impact of these techniques on ecosystems is controversial. Trawling is highly dependent on fossil fuels. Life cycle analyses of the fish value chain, from catch to consumer, show that it is the exploitation stage at sea that has the largest carbon footprint (Thrane, 2006), leading some authors to include only the fleet sector in their analyses of the impact on greenhouse gas production (Schau *et al.*, 2009).

The most recent controversy centres on a worldwide player, the Marine Stewardship Council (MSC). This organisation was originally an initiative of an NGO – the World Wildlife Fund (WWF) - and a multinational company - Unilever -. Since 2000, it has offered a sustainable fishing label to fishermen who apply for it, based on a target species, a fishing zone and a fishing technique. The scientific literature is fuelling controversy about sustainable fishing labels, with the dominant case being the MSC label (Wijen and Chiroleu-Assouline, 2019; Hønneland, 2020; Le Manach *et al.*, 2020,). More than 300 fisheries worldwide have been awarded the MSC label. In France, 12 fisheries are certified, including two in coastal areas: the Granville whelk and the Saint-Brieuc

scallop.

When it comes to this controversial issue, consumers do not have the same level of information. While the results of the logit model shed little light on the aspect of knowledge between the two samples, the means comparison tests provides some interesting information. This test breaks down the questions into different types of knowledge. Coastal consumers are more likely to reject the statement that "*the production method (wild or farmed) is not mandatory information for FAP sold fresh*". In 2013, the European Commission adopted a regulation requiring FAP to be labelled when sold to consumers. Shoppers will need to know the scientific name of the species, the commercial name, the production method (wild or farmed) and the origin (fishing zone or farming country). Geographical proximity speeds up the flow of information to coastal communities and contributes to the local knowledge dynamics. However, this information is intended for all consumers to distinguish between wild and farmed products, regardless of where they live. Geographical proximity is the main vector for the circulation of information among coastal households. Their role is therefore not insignificant in a territorial knowledge dynamic, sometimes hidden behind the argument of lower environmental impact.

This article has several important limitations that must be considered when interpreting the results. Firstly, choosing coastal départements to distinguish between the two samples may seem questionable. At the level of a coastal département, it is possible to obtain similar results by separating households living in coastal municipalities (using the coastline and a physical distance) from households living in municipalities without a coastline, i.e. not coastal. In our case, the choice of département as a reference is defended to ensure the statistical comparability of the samples (439 coastal and 794 non-coastal). A second limitation concerns the survey period during the post-COVID period, with relaxed containment measures and the closure of commercial catering. The sampling method (quota sampling) has limitations related to selection bias. However, this method is still widely accepted in the consumer behaviour literature (Salladarré *et al.*, 2013; Lucas *et al.*, 2019), as it allows us to approach the general structure of a population in order to study all its components. Finally, our sample contains an overrepresentation of white-collar workers to the detriment of blue-collar workers. This can be explained by the typical structure of FAPs consumers (Hicks *et al.*, 2008).

## 4.7 - Conclusion

The results of this research open up a number of perspectives for regional science related to a highly territorialised industry. The first extension is to test the same hypotheses - the strong influence of geographical proximity - at the European scale. A second extension is a response to the limits of coastal character at the departmental level. At what physical distance from the coastline or from a local production system (fishing port or shellfish basin) can we expect a decrease in knowledge sharing among consumers? This work opens new avenues to demonstrate that the FAP industry is highly territorialised, producing new knowledge that is still insufficiently shared with consumers as a whole.

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# 4.8 - Appendix

## Table 4.A1 - The variables included in the logit model with marginal effects

| Variables | Modalities | Signification | Variable construction | Response modalities |
|---|---|---|---|---|
| Preferences for FAPs | *Fresh* | Consumers prefer to buy fresh fish (whole or cuts) rather than canned, processed or frozen. | Likert scale | From 0 (Strongly disagree) to 10 (Strongly agree) |
| | *Wild* | Consumers prefer to buy wild fish | | |
| | *Local* | Consumers prefer fish from their region | | |
| | *Environment* | Consumers take environmental issues into account when buying fish | | |
| | *France* | Consumers prefer fish from France | | |
| | *Farmed* | Consumers prefer to buy farmed fish | | |
| | *Health risk* | Consumers take health risks into account when buying fish | | |
| | *EU* | Consumers prefer EU fish | | |
| Knowledge | *Subj.* | Consumers feel knowledgeable about FAPs (self-assessment) | Total score attributed to 4 Likert scale questions | From 0 (Strongly disagree) to 10 (Strongly agree) |
| | *Obj.* | Consumers have knowledge about FAPs | Total score based on correct answers to 4 “true/false” questions. 1 if correct, 0 if wrong | True, False |
| | *Label* | Consumers see labels as an effective consumer information tool | Likert scale | De 0 (Pas du tout d’accord) à 10 (Tout à fait d’accord) |
| | *Specific* | Consumers know the origin of the salmon/cod consumed on the French market | Multiple choice question | Moins de 25 % ; De 25 à 50 % ; De 51 à 75 % ; Plus de 75 % |
| Age (reference + 65) | *[50-64]*<br>*[35-49]*<br>*[18-34]* | Age category of the consumer | Open numeric question | Numerical value |
| Gender (reference Women) | *Men* | Gender of the consumer | Multiple choice question | Female; Male; Don't know |
| Purchasing channels | *Supermarkets* | Buys most of its FAPs in supermarkets | Main seafood purchasing channel<br>Coded 1 if the majority (most of the time) of the consumer's FAPs purchases are made through the channel considered. Otherwise 0. | Most of the time (selectable for a single circuit); From time to time; Never |
| | *Direct selling* | Buys most of its seafood directly from fishermen’s | | |
| | *Specialised shops* | Buys most of its FAPs in specialised shops | | |
| | *Fishmongers* | Buys most of his PAF from the fishmonger's | | |

Source - COPECO/RCN survey - 2021

## 4.9 - References

**Aerni, P.** (2004). Risk, regulation and innovation: The case of aquaculture and transgenic fish. Aquatic Sciences, 66(3), 327–341. https://doi.org/10.1007/s00027-004-0715-8

**Alban, F., Le Floc'h, P., Daurès, F., Guyader, O., & Thébaud, O.** (2022a). L'impact économique de la Covid-19 sur les pêches maritimes françaises. Économie rurale, 380(2), 27–39. https://doi.org/10.4000/economierurale.9925

**Alban, F., Sophie, L., & Le Floc'h, P.** (2022b). Les halles à marée françaises au temps du confinement en 2020. Dévellopement Durable et Territoires, 13(2), 0–28. https://doi.org/https://doi.org/10.4000/developpementdurable.21122

**Brécard, D., Hlaimi, B., Lucas, S., Perraudeau, Y., & Salladarré, F.** (2009). Determinants of demand for green products: An application to eco-label demand for fish in Europe. Ecological Economics, 69(1), 115–125. https://doi.org/10.1016/j.ecolecon.2009.07.017

**Brécard, D., Lucas, S., Pichot, N., & Salladarré, F.** (2012). Consumer preferences for eco, health and fair trade labels. An application to seafood products in France. Journal of Agricultural and Food Industrial Organization, 10(1). https://doi.org/https://doi.org/10.1515/1542-0485.1360

**Chalaye, S., & Massard, N.** (2009). Les clusters: Diversité des pratiques et mesures de performance. Revue d'Economie Industrielle, 128(4), 153–176. https://doi.org/10.4000/rei.4079

**Colletis-Wahl, H.-K., Peyrache-Gadeau, V., & Serrate, B.** (2008). Introduction générale. Les dynamiques territoriales : quelles nouveautés ? Revue d'Économie Régionale & Urbaine, juin(2), 147–157. https://doi.org/10.3917/reru.082.0147

**Crevoisier, O., & Jeannerat, H.** (2009). Les dynamiques territoriales de connaissance: Relations multilocales et ancrage régional. Revue d'Economie Industrielle, 128(4), 77–99. https://doi.org/10.4000/rei.4072

**Crevoisier, O.** (2011). Dynamiques territoriales de connaissance et milieux ancreurs en Europe (No. 8). https://doc.rero.ch/record/27942/files/Crevoisier_Olivier_-_La_circulation_du_capital._Dynamiques_territoriales_de_connaissance_et_milieux_ancreurs_en_Europe_20111209.pdf

**Dosi, G.** (1982). Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. Research Policy, 11(3), 147–162. https://doi.org/https://doi.org/10.1016/0048-7333(82)90016-6

**Eigaard, O. R.** (2009). A bottom-up approach to technological development and its management implications in a commercial fishery. ICES Journal of Marine Science, 66(5), 916–927. https://doi.org/10.1093/icesjms/fsp084

**Forest, J., & Serrate, B.** (2011). Diffusion et production des connaissances : les deux faces d'une action territoriale réussie. *Revue d'Économie Régionale & Urbaine*, *avril*(2), 295–312. https://doi.org/10.3917/reru.112.0295

**Freeman, C.** (1991). Innovation, Changes of Techno-Economic Paradigm and Biological Analogies in Economics. Revue Économique, 42(2), 211–231. http://www.jstor.org/stable/3502005

**Gordon, D. V, & Hannesson, R.** (2015). The Norwegian Winter Herring Fishery: A Story of Technological Progress and Stock Collapse. Land Economics, 91(2), 362–385. https://doi.org/10.3368/le.91.2.362

**Grabher, G., Ibert, O., & Flohr, S.** (2008). The Neglected King: The Customer in the New Knowledge Ecology of Innovation. Economic Geography, 84(3), 253–280. https://doi.org/https://doi.org/10.1111/j.1944-8287.2008.tb00365.x

**Greene, W.** (2018). Econometric Analysis - 8th Edition (Pearson (ed.); 8th ed.). Pearson Education Limited.

**Heutte, K., Daures, F., Lucas, S., Girard, S., Alban, F., & Le Floc'h, P.** (2023). Fisheries and aquaculture products consumption in France: when the Covid-19 crisis did not lead to more sustainable purchases. Aquatic Living Resources, 36(10), 19p. https://doi.org/https://doi.org/10.1051/alr/2023004

**Hicks, D., Pivarnik, L., & McDermott, R.** (2008). Consumer perceptions about seafood - an Internet survey. Journal of Foodservice, 19(4), 213–226. https://doi.org/10.1111/j.1748-0159.2008.00107.x

**Hønneland, G.** (2020). Marine Stewardship Council (MSC) Certification of Arctic Fisheries. Arctic Review on Law and Politics, 11, 133–156. https://www.jstor.org/stable/48710628

**Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X.** (2013). Applied Logistic Regression. In Wiley (Ed.), Wiley Series in Probability and Statistics (3rd ed., Vol. 47, Issue 4). https://doi.org/10.2307/2532419

**Jeannerat, H., & Kebir, L.** (2015). Knowledge, Resources and Markets: What Economic System of Valuation? Regional Studies, 50(2), 274–288. https://doi.org/10.1080/00343404.2014.986718

**Lazuech, G., & Debucquet, G.** (2017). Culture alimentaire et accord marchand local. Une enquête au sein de l'AMAP « Poisson » Yeu-Continent. Terrains & travaux, 31(2), 129–155. https://doi.org/10.3917/tt.031.0129

**Le Floc'h, P., & Fuchs, J.** (2001). Economics of science in fishery sector—the European case. Marine Policy, 25(2), 133–142. https://doi.org/https://doi.org/10.1016/S0308-597X(01)00004-5

**Le Floc'h, P., Merzéréaud, M., Beckensteiner, J., Alban, F., Duhamel, E., Thébaud, O., & Wilson, J.** (2023). Explaining technical change and its impacts over the very long term: The case of the Atlantic sardine fishery in France from 1900 to 2017. Research Policy, 52(9), 104864. https://doi.org/https://doi.org/10.1016/j.respol.2023.104864

**Le Manach, F., Jacquet, J. L., Bailey, M., Jouanneau, C., & Nouvian, C.** (2020). Small is beautiful, but large is certified: A comparison between fisheries the Marine Stewardship Council (MSC) features in its promotional materials and MSC-certified fisheries. PloS One, 15(5), e0231073. https://doi.org/10.1371/journal.pone.0231073

**Le Roux, A., & Thébault, M.** (2018). Territoire et territoire numérique de la résistance des consommateurs. Une étude exploratoire. Questions de Communication. https://doi.org/10.4000/questionsdecommunication.15534

**Le Velly, R., & Dufeu, I.** (2016). Alternative food networks as "market agencements": Exploring their multiple hybridities. Journal of Rural Studies, 43, 173–182. https://doi.org/https://doi.org/10.1016/j.jrurstud.2015.11.015

**Lucas, S., Gouin, S., & Lesueur, M**. (2019). Seaweed consumption and label preferences in France. Marine Resource Economics, 34(2), 143–162. https://doi.org/10.1086/704078

**Maillat, D.** (1995). Territorial dynamic, innovative milieus and regional policy. Entrepreneurship & Regional Development, 7(2), 157–165. https://doi.org/10.1080/08985629500000010

**Maillat, D., & Kebir, L.** (1999). Learning region et systèmes territoriaux de production. Revue d'économie Régionale et Urbaine, 3, 429–448. https://hal.science/hal-01456519

**Martin, H., Martin, R., & Zukauskaite, E.** (2019). The multiple roles of demand in new regional industrial path development: A conceptual analysis. Environment and Planning A: Economy and Space, 51(8), 1741–1757. https://doi.org/10.1177/0308518X19863438

**McFadden, D.** (1974). Conditional logit analysis of qualitative choice behaviour. *Frontiers in Econometrics*, 105–142.

**McFadden, D., & Train, K.** (2000). Mixed MNL models for discrete response. Journal of Applied Econometrics, 15(5), 447–470. https://doi.org/10.1002/1099-1255(200009/10)15:5<447::aid-jae570>3.0.co;2-1

**Menozzi, D., Nguyen, T. T., Sogari, G., Taskov, D., Lucas, S., Castro-Rial, J. L. S., & Mora, C.** (2020). Consumers' preferences and willingness to pay for fish products with health and environmental labels: Evidence from five european countries. Nutrients, 12(9), 1–22. https://doi.org/https://doi.org/10.3390/nu12092650

**Overall, J. E., Atlas, R. S., & Gibson, J. M.** (1995). Tests That are Robust against Variance Heterogeneity in k × 2 Designs with Unequal Cell Frequencies. Psychological Reports, 76(3), 1011–1017. https://doi.org/10.2466/pr0.1995.76.3.1011

**Pistorius, C. W. I., & Utterback, J. M.** (1997). Multi-mode interaction among technologies. Research Policy, 26(1), 67–84. https://doi.org/https://doi.org/10.1016/S0048-7333(96)00916-X

**Prensky, M.** (2001). Digital Natives, Digital Immigrants Part 1. On the Horizon, 9(5), 1–6. https://doi.org/10.1108/10748120110424816

**Rotter, A., Barbier, M., Bertoni, F., & Edwards, C.** (2021). The essentials of marine biotechnology. Frontiers in Marine Science, 8. https://doi.org/10.3389/fmars.2021.629629

**Salladarré, F., Guillotreau, P., Perraudeau, Y., & Monfort, M. C.** (2010). The demand for seafood eco-labels in France. Journal of Agricultural and Food Industrial Organization, 8(1). https://doi.org/10.2202/1542-0485.1308

**Salladarré, F., Guillotreau, P., Lesage, C.-M., & Ollivier, P.** (2013). Les préférences des consommateurs pour un écolabel. Le cas des produits de la mer en France. Revue d'étude En Agriculture et Environnement, 94(3), 1–22. https://doi.org/10.4074/ S1966960713003044

**Salladarré, F., Guillotreau, P., Debucquet, G., & Lazuech, G.** (2018). Some Good Reasons for Buying Fish Exclusively From Community-Supported Fisheries: The Case of Yeu Island in France. Ecological Economics, 153(December 2017), 172–180. https://doi.org/10.1016/j.ecolecon.2018.07.017

**Schau, E. M., Ellingsen, H., Endal, A., & Aanondsen, S. A.** (2009). Energy consumption in the Norwegian fisheries. Journal of Cleaner Production, 17(3), 325–334. https://doi.org/https://doi.org/10.1016/j.jclepro.2008.08.015

**Schumpeter A.J** (1939) Business Cycles. A Theoretical, Historical, and Statistical Analysis of the Capitalist Process. McGraw-Hill, New York.

**Sverrisson, Á.** (2002). Small Boats and Large Ships: Social Continuity and Technical Change in the Icelandic Fisheries, 1800-1960. Technology and Culture, 43, 227–253. http://dx.doi.org/10.1353/tech.2002.0092

**Thrane, M.** (2006). LCA of Danish Fish Products. New methods and insights (9 pp). The International Journal of Life Cycle Assessment, 11(1), 66–74. https://doi.org/10.1065/lca2006.01.232

**Torre, A., Rallet, A., Lung, Y., Pecqueur, B., Lecoq, B., Colletis, G., & Bellet, M.** (1992). Études Empiriques : Et pourtant ça marche ! (quelques reflexions sur l'analyse du concept de proximité). Revue d'économie Industrielle, 61(1), 111–128. https://doi.org/10.3406/rei.1992.1443

**Valdemarsen, J. W.** (2001). Technological trends in capture fisheries. Ocean & Coastal Management, 44(9), 635–651. https://doi.org/https://doi.org/10.1016/S0964-5691(01)00073-4

**van Wyk, R. J., & Wessels, J. P. H.** (1987). Focussing a co-operative industrial research institute: A case study. Research Policy, 16(1), 39–48. https://doi.org/https://doi.org/10.1016/0048-7333(87)90005-9

**von Hippel, E.** (1978). Successful Industrial Products from Customer Ideas. Journal of Marketing, 42(1), 39–49. https://doi.org/10.2307/1250327

**Whitmarsh, D. J., Reid, C. A., Gulvin, C., & Dunn, M. R.** (1995). Natural Resource Exploitation and the Role of New Technology: a Case-history of the UK Herring Industry. Environmental Conservation, 22(2), 103–110. https://doi.org/10.1017/S0376892900010146

**Wijen, F., & Chiroleu-Assouline, M.** (2019). Controversy Over Voluntary Environmental Standards: A Socioeconomic Analysis of the Marine Stewardship Council. Organization \& Environment, 32(2), 98–124. https://doi.org/10.1177/1086026619831449

**Zander, K., & Feucht, Y.** (2018). Consumers' Willingness to Pay for Sustainable Seafood Made in Europe. Journal of International Food and Agribusiness Marketing, 30(3), 251–275. https://doi.org/https://doi.org/10.1080/08974438.2017.1413611

# General conclusion

The general objective of this thesis is to provide recommendations to public policymakers on how to promote the sustainable consumption of FAPs, focusing on the role of labelling schemes. Firstly, this work aims to provide better understanding of the consistency between consumption patterns in the French market and the objectives of "sustainable and healthy" food consumption (**Chapter 1**). Although France is a country with high average FAP consumption (33kg/capita in 2021), this work highlights the unsustainable nature of this consumption. Our results indicate that this consumption is driven by a limited proportion of the population (46% of the population eats FAPs at least once a week). This group is primarily comprised of older, high-income consumers who are knowledgeable about the sector. Moreover, market data shows that this consumption is based on a small number of species, often criticised for reasons of lack of sustainability, and which are mostly imported. French consumption of FAPs is, therefore, unsustainable, both from an environmental point of view and in terms of the public health objectives set by ANSES (2 portions of FAPs per week). Following this observation, this thesis discusses various levers to guide French consumers towards more sustainable consumption of FAPs.

Firstly, this thesis supports the idea of better-integrating FAPs into public food policies, as advocated by several authors (Béné *et al.*, 2015; Tigchelaar *et al.*, 2022). Indeed, despite interesting attributes, FAPs are dealt with only marginally within existing policies. Considering these products in the same way as meat, fruit, and vegetables is an essential first step towards making fisheries systems more sustainable, and more notably, our consumption patterns.

## 5.1 - Taking environmental considerations into account in information policies

In order to achieve the objectives of sustainable FAP consumption, it is necessary for consumers to be better informed about species whose production methods meet environmental and resource conservation objectives (**Chapter 1**). This implies integrating the environmental dimension fully into existing initiatives aimed at promoting the consumption of FAPs. In particular, this work addresses the issue of the nutritional recommendations proposed by ANSES, which currently do not include any consideration of the species and/or products to be consumed (apart from the distinction between fatty and lean species). To encourage more sustainable behaviours, a list of virtuous species should be proposed to consumers, taking into account criteria such as stock exploitation, species seasonality, etc. Another approach would be to base nutritional recommendations on a Lancet-type approach, which directly integrates environmental considerations (such as loss of biodiversity, $CO_2$ emissions, and water use) into their recommendations. Compliance with these recommendations would result in a reduction in FAP consumption for a country like France of approximately 10 kg of FAPs per year and per inhabitant (based on a daily consumption of 28 g of FAPs), thereby contributing to the objective of preserving the resource[36].

"Mass-media" campaigns can also be a useful tool to inform consumers on a large scale about the sustainable

[36] Provided that this surplus is not consumed in another country which is already consuming more than required.

consumption of FAPs. However, a study carried out by EUMOFA in 2017 found that these campaigns tend to be limited to promoting attributes such as the domestic origin of the product. While the territorial nature of production is important, particularly for issues of support for the sector, environmental issues must be explicitly incorporated into the messages provided to consumers (**Chapter 1**).

## 5.2 - Heterogeneous preferences for labelled FAPs

In a market with considerable competition between labels, this study seeks to understand how consumer preferences for different labels are structured in relation to each other (**Chapter 2**). Overall, these preferences are very heterogeneous. Consumers express a strong preference for quality labels and "France origin" labels. Ecolabels, "safety" claims and animal welfare labels are sought after by a smaller proportion of the population, as are labels relating to the local origin of FAPs. This heterogeneity highlights the difficulty of implementing a public information policy (including labelling) that meets all the public's expectations concerning FAPs. Generalist labelling policies are not necessarily effective communication tools. A message tailored according to the target audience can be more efficient. Our results show, for example, the influence of age on these preferences: the over-65s are more likely to pay attention to "France origin" labels or "safety" claims, while the 18-34s will be more interested in ecolabels or animal welfare labels. Our analyses also show that motivations are structuring factors in the demand for labelled FAPs. People who are attached to the origin of their FAPs will logically prefer origin labels, while consumers with a certain degree of altruism will prefer ethical labels. This diversity of consumption profiles and expectations regarding FAPs needs to be better integrated by public policymakers.

## 5.3 - The issue of ecolabels

Although ecolabels are developing strongly in the sector (Lucas *et al.*, 2021), they are not a primary choice criterion for FAP consumers (Zander *et al.*, 2018). Consumers tend to prioritize other attributes, such as price, presentation, or familiarity with the product when making purchases. Our results also highlight a stronger preference for other labelling approaches (**Chapter 2**). Indeed, in a situation of multiple-choice, consumers generally tend to prefer labels that ensure superior product quality or personal benefit rather than labels that focus on social well-being, including ecolabels. In other words, French consumers' labelling preferences are mainly driven by selfish motives when given a choice.

To achieve the global objectives concerning environmental protection and the conservation of marine resources, the demand for ecolabels must be promoted and established as a primary criterion for consumer choices. Increasing consumer information and education is thus of paramount importance. Indeed, the results indicate that consumer knowledge of environmental issues is uneven, particularly among non-coastal households (**Chapter 4**). A more comprehensive grasp of these issues could prompt consumers to adopt a more assertive stance in favour of these approaches.

Furthermore, because of the proliferation of these ecolabels, "dubious ecolabels" (Grolleau *et al.*, 2016) can

enter the market[37]. Consumers who are unfamiliar with the sector and the labels are limited in their ability to discriminate between all these approaches, leading to a risk of adverse selection or even the rejection of ecolabels. This results in global mistrust among consumers (Giacomarra *et al.*, 2021) and limits the ability of virtuous ecolabels to change existing consumer behaviour. To reduce this information asymmetry, this paper argues for introducing a more restrictive regulatory framework for ecolabels, in order to reduce the entry of these "dubious" labels into the market. Another potential avenue for reassuring consumers regarding ecolabels could be the promotion of public initiatives, which consumers perceive as more trustworthy. However, as evidenced by the recent introduction of the public ecolabel "Pêche Durable[38]" in France, these labels may encounter resistance in penetrating a market where several approaches (MSC, ASC, AB, Naturland, etc.) have established a dominant market position.

Despite these limitations, our results show that consumers are prepared to pay a price premium for a "trusted" ecolabel on their FAPs (**Chapter 3**). The price premium is evident both for wild species (+€1.60 per kilo) and aquaculture species (+€1.52 per kilo), indicating consumer interest in the environmental impact of FAP consumption. Overall, this interest appears to be more pronounced among younger generations. As previously stated, in a "multiple choices" approach, younger individuals tend to exhibit a stronger inclination towards ecolabels (**Chapter 2**). This results in a higher WTP for these approaches compared to their elders (in the case of wild fish species) (**Chapter 3**). In addition, younger consumers may be more receptive to dietary change as they are less susceptible to "habitus" in their consumption than older generations. As the "consumers of tomorrow", younger generations are a priority target segment for the development of sustainable consumption of FAPs, and their awareness and education are essential.

However, although young consumers express strong positioning regarding the ethical consumption of FAPs, our results show that they also consume relatively few FAPs (**Chapter 1**). This raises a double question. How can we encourage this population to consume more FAPs, particularly for public health reasons (obesity rates are very high in this population), and at the same time mobilise this generation's interest in environmental issues? Labels may be one solution, but other levers also exist. In this thesis, the importance of the school canteen as a place for disseminating information and education is discussed (**Chapter 1**). Indeed, it is both a forum for raising awareness of FAPs among individuals who may not be directly confronted with them in their domestic consumption patterns, and a venue for the promotion of best practices. It can be a place for promoting species that are more local and more sustainable than those currently consumed in France. This duality has already been identified by the agricultural sector, with the introduction of organic and vegetarian meals in French school canteens to promote new diets. The fishing industry must also seize this opportunity.

[37] For example, in 2012, labels used by French distributors were withdrawn from sale because they were considered misleading to consumers.
[38] For more information on this label: https://agriculture.gouv.fr/lecolabel-public-peche-durable

## 5.4 - Diversifying consumption by promoting national species

The diversification of consumption is presented as a key factor in the transition of food systems towards greater sustainability. This work discusses the necessity to substitute high-consumption species, which are mainly imported, with under-utilised and domestic species (**Chapter 1**). From the standpoint of sustainability, promoting the consumption of domestic species has several advantages, particularly in terms of their environmental attributes. Consuming locally means reducing $CO_2$ emissions linked to the transport of imported species. In addition, this could reduce fishing pressure on certain stocks that supply the French market (e.g., tuna from the Indian Ocean) to the detriment of local populations (which would also contribute to greater equity in access to the resource). Finally, domestic species are managed within the framework of the CFP, while the management regimes for imported species may be less transparent. From an economic perspective, the enhancement of the value of these domestic species, particularly through the creation of new markets, could also support a sector weakened by the impact of the COVID-19 pandemic, Brexit, the energy crisis, etc.

Consequently, our surveys demonstrate an interest among French consumers in the domestic origin of the FAPs they consume (**Chapter 2**). In a multiple-choice situation, consumers indeed express a marked preference for the "France origin" label and the "local origin" label. Developing the use of these labels could be an important lever to encourage the diversification of consumption towards domestic species. However, local attributes should not replace environmental ones. These labels of origin must, therefore, include binding criteria on environmental aspects.

On the supply side, French fishing landings can help to meet these diversification challenges (**Chapter 1**). Indeed, this sector lands a great variety of species (around 300 according to IFREMER (2024)). This diversity of landings offers opportunities to respond to the price barrier that structures the demand for FAPs. Indeed, the "price" criterion keeps many households away from access to FAPs. Whereas the species currently most consumed are expensive species, better use of this diversity of species landed implies a diversity of prices offered to consumers. Species such as fresh sardines (€6.2 per kilo in 2022) or fresh mackerel (€8.2 per kilo in 2022) are more accessible than species subject to far higher consumption (approximately €20 per kilo in 2022 for salmon and cod) (FranceAgriMer, 2023). In addition, the species landed by French fisheries are mainly marketed fresh. This can help to limit the growing consumption of processed FAPs, which are more expensive (average price of €15.1 per kilo for processed products compared to an average price of €12.9 per kilo for fresh products) (FranceAgriMer, 2023) and questioned in terms of their impact on public health.

## 5.5 - Proximity to the coast, a structuring feature of the French market

To achieve more sustainable consumption of FAPs in France, proximity to the sea needs to be better integrated from the consumers' perspective (**Chapter 4**). Indeed, France has a long coastline where fishing and aquaculture are important cultural anchors. FAP consumption is higher in coastal areas than in more remote regions, highlighting the influence of place of residence on dietary behaviour (**Chapter 2 & 4**). This work

demonstrates that households living in a coastal *département* have preferences: 1) for FAPs originating from their territory; 2) for the labels associated with them. On the other hand, they will be less likely to prefer "France origin" labels, which are more sought after by non-coastal populations. Furthermore, these coastal households, while expressing a preference for FAPs produced using methods with low environmental impact, express less preference for ecolabels. According to Salladarré *et al.* (2010), these ecolabels can be perceived as calling into question the fishing activities taking place on the territory. This thesis also discusses the impact of controversies surrounding ecolabelling on the preferences of coastal consumers (**Chapter 4**), who are more knowledgeable about the sector than those living further inland. In order to promote the sustainable consumption of FAPs in these coastal areas, "local origin" labels thus seem to be better suited to the expectations of coastal consumers than ecolabels (**Chapter 2**). Existing initiatives to promote local fisheries in the French market support this thesis result[39]. However, as argued above, locality is not necessarily synonymous with environmental sustainability. Therefore, linking these approaches to restrictive environmental criteria is essential.

## 5.6 - The question of production methods

Our work demonstrates the importance of better considering the existence of the two production methods in public food policies. Although, at the production level, there is a strong distinction between public policies directed at fisheries and public policies directed at aquaculture, this is not the case at the consumption level, where FAPs are often treated as a homogeneous whole. However, our results show that consumers have different expectations regarding these two types of products. In general, consumers perceive fishery products to be of higher quality than aquaculture products, particularly in terms of nutrition and safety attributes (**Chapter 1**). This is reflected at the WTP level for "safety" claims for aquaculture species (+ €1.81) which are highly valued by consumers (**Chapter 3**). Reassuring consumers about these safety aspects seems crucial if European aquaculture is to develop as a low-carbon and sustainable food source[40]. Although lower, the average consumer WTP for ecolabels (+ €1.52) also shows that the environmental dimensions of aquaculture production are also considered by consumers.

For wild products, consumers express a positive WTP for ecolabelling approaches (+ €1.60), highlighting their awareness of the environmental issues associated with fishing. Moreover, our results tend to confirm a growing concern about health risks associated with marine pollution, with significant WTP for safety claims (+ €1.45). In general, these results show a stronger association between environmental issues and wild fisheries, and a stronger association between safety issues and aquaculture. This dichotomy, which overlaps with certain findings in the literature (Zander and Feucht, 2018), should be better taken into account by public policies that seek to promote the consumption of sustainable FAPs.

[39] The oldest program was created in 1998 by the Normandy sector: https://www.normandiefraicheurmer.fr/
[40] According to the Roadmap for Sustainable Aquaculture in Europe: https://ec.europa.eu/commission/presscorner/detail/en/ip_21_1554

## 5.7 - Multi-labelling for consumer guidance

In the global context of the reform of "health and environment" food systems, this thesis focuses on the potential association of an ecolabel and the claim of safety regarding the same FAPs (**Chapter 3**). Work on multi-labelling is scarce in the FAP sector. This work provides interesting elements for discussion. In particular, it highlights a higher WTP for single-labelled FAP than for double-labelled FAP when the single label is linked to the attribute most valued by consumers regarding production methods (environmental attribute for fishery products and safety attribute for aquaculture products). In this case, adding additional information through a second label is perceived as "noise" by the consumer, leading to a negative marginal WTP. This result is consistent with the work of Bougherara *et al.* (2007), which suggests that there is an optimal level of information for consumers. For producers, this demonstrates the benefits of communicating through a single label rather than trying to add too many labels to their product, especially if their production already meets the main expectations of consumers. Conversely, if the unique label stamped on the product is not linked to the attribute most valued by consumers, adding a second label referring to it leads to a positive marginal WTP. This result also implies that aquaculture producers who already meet the specifications of an ecolabel, such as the organic label, have an interest in better informing consumers about the existence of health criteria inherent in this label in order to increase the value of their production.

Although dual labelling could be a potential lever to respond to the diversity of preferences expressed by consumers, there is a need to reassure them about the potential effectiveness of these approaches. Indeed, our results show that older consumers, who are regular FAP consumers, may be sceptical of these approaches, with a reduced WTP for these approaches. This paper discusses potential levers to increase consumer acceptance of these dual-labelled FAPs. It is above all essential to avoid associating labels that are perceived as non-complementary by these consumers. In addition, the use of labels perceived by consumers as reliable and trustworthy can also be effective. In this respect, labels from public institutions offer opportunities.

## 5.8 - Barriers to labelling initiatives

The different results presented allow us to discuss certain barriers to labelling policies. Firstly, there is a lack of consumer confidence in labels and, more specifically, in ecolabels. Indeed, consumers with a high degree of PCE prefer ecolabels in a multiple-choice situation (**Chapter 2**). However, introducing a budget constraint seems to hold this positioning back, with a negative correlation between a high degree of PCE and WTP for ecolabels (also verified for safety claims) (**Chapter 3**). These crossed results appear to indicate that consumers who believe they can influence the future of our planet through their individual choices do not perceive labels as a financially effective tool. Furthermore, the results of this thesis show that the price associated with labels is also a barrier to the preferences expressed for labels. In a multiple-choice situation, consumers who are price-conscious when purchasing FAPs will be more likely to look for non-labelled FAPs (**Chapter 2**). In addition, 20% of respondents (**Chapter 3**) are unwilling to pay extra for a label on an FAP that they already consider too expensive. For the

development of virtuous labels to be successful, public authorities also need to take better account of the existence of these barriers.

## 5.9 - Limits and openings

However, the results presented in this thesis may be subject to several limitations. Our results are based on declarative data. It is, therefore, difficult, in the light of current knowledge, to know whether these declared behaviours are translated into real purchasing behaviour. Indeed, the existing literature often highlights a "behaviour gap", notably regarding green consumption (Young *et al.*, 2010). In a declarative survey, consumers tend to orient their responses due to a social desirability bias. This gap is also particularly prevalent among young generations, who may lack the financial resources to fulfil their positioning for the environment. In addition, all the labels presented to consumers are hypothetical. Even if we presented these schemes as trustable, working on hypothetical labels can influence consumers' preferences and positioning. Finally, social considerations remain marginally discussed in this work. Although they are essential when we talk about sustainability, they remain secondary from the consumer's point of view. Nevertheless, more knowledge on this specific topic is essential.

This thesis also allows discussing the needs of research in order to successfully guide consumers towards more sustainable consumption of FAPs, in particular regarding labelling initiatives. Firstly, there is a real need for data on labels at the firm and retail outlet levels. These purchasing data are essential to obtain a more complete picture of the place of labels in the sector. This could in particular help to address the issue of the gap between declared behaviour and actual purchasing behaviour discussed above. However, these data are very limited in the FAP sector. Although the issue of multi-labelling is addressed in this thesis, it is still worth discussing further. An interesting avenue could be to try to measure the influence of certification bodies (public *vs*. private) on the acceptance of these approaches. Along same lines, carrying out behavioural economics research to improve the uptake of these multi-labelled products may also be of interest. Given the preferences expressed by consumers for labelled FAPs, and current trends in the food market, it may also be interesting to study the association between a label of origin and an ecolabel, notably local labels in coastal areas. The results discussed in this thesis also raise the question of the place of a metal label in the FAP sector (a label that includes a large set of criteria related to sustainability issues), as discussed by Sonntag *et al.* (2023). Indeed, this label could be a response to the limitations currently encountered by labelling initiatives, in particular with regard to the issues of heterogeneity of preferences and information overload. However, the feasibility of such a label remains highly debatable, especially as the concept of sustainability itself is not yet well defined.

## 5.10 - References

**Béné, C., Barange, M., Subasinghe, R., Pinstrup-Andersen, P., Merino, G., Hemre, G. I., & Williams, M.** (2015). Feeding 9 billion by 2050 – Putting fish back on the menu. Food Security, 7(2), 261–274. https://doi.org/10.1007/s12571-015-0427-z

**Bougherara, D., Grolleau, G., & Mzoughi, N.** (2007). Is more information always better? An analysis applied to information-based policies for environmental protection. International Journal of Sustainable Development, 10(3), 197–213. https://doi.org/10.1504/IJSD.2007.017643

**FranceAgriMer.** (2023). Consommation des produits de la pêche et de l'aquaculture 2022. In Données et bilans de l'Etablissement national des produits de l'agriculture et de la mer. https://www.franceagrimer.fr/content/download/72643/document/STA_MER_CONSO_2022.pdf

**Giacomarra, M., Crescimanno, M., Vrontis, D., Miret Pastor, L., & Galati, A.** (2021). The ability of fish ecolabels to promote a change in the sustainability awareness. Marine Policy, 123(November 2020), 104292. https://doi.org/10.1016/j.marpol.2020.104292

**Grolleau, G., Ibanez, L., Mzoughi, N., & Teisl, M.** (2016). Helping eco-labels to fulfil their promises. Climate Policy, 16(6), 792–802. https://doi.org/10.1080/14693062.2015.1033675

**IFREMER**. (2024). Bilan 2023 du statut des ressources halieutiques débarquées par la pêche française hexagonale en 2022. https://archimer.ifremer.fr/doc/00877/98852/

**Lucas, S., Soler, L.-G., & Revoredo-Giha, C.** (2021). Trend analysis of sustainability claims: The European fisheries and aquaculture markets case. Food Policy, 104(July), 102141. https://doi.org/https://doi.org/10.1016/j.foodpol.2021.102141

**Tigchelaar, M., Leape, J., Micheli, F., Allison, E. H., Basurto, X., Bennett, A., Bush, S. R., Cao, L., Cheung, W. W. L., Crona, B., DeClerck, F., Fanzo, J., Gelcich, S., Gephart, J. A., Golden, C. D., Halpern, B. S., Hicks, C. C., Jonell, M., Kishore, A., … Wabnitz, C. C. C.** (2022). The vital roles of blue foods in the global food system. Global Food Security, 33, 100637. https://doi.org/https://doi.org/10.1016/j.gfs.2022.100637

**Sonntag, I.W., Lemken, D., Spiller, A., & Schulze, M.** (2023). Welcome to the (label) jungle? Analyzing how consumers deal with intra-sustainability label trade-offs on food. Food Quality and Preference, 104, 104746. https://doi.org/https://doi.org/10.1016/j.foodqual.2022.104746

**Young, W., Hwang, K., McDonald, S., & J Oates, C.** (2010). Sustainable consumption: green consumer behaviour when purchasing products. Sustainable Development, 18(March 2009), 20–31. http://dx.doi.org/10.1002/sd.394

**Zander, K., & Feucht, Y.** (2018). Consumers' Willingness to Pay for Sustainable Seafood Made in Europe. Journal of International Food and Agribusiness Marketing, 30(3), 251–275. https://doi.org/https://doi.org/10.1080/08974438.2017.1413611

**Zander, K., Risius, A., Feucht, Y., Janssen, M., & Hamm, U.** (2018). Sustainable Aquaculture Products: Implications of Consumer Awareness and of Consumer Preferences for Promising Market Communication in Germany. Journal of Aquatic Food Product Technology, 27(1), 5–20. https://doi.org/10.1080/10498850.2017.1390028

# French thesis summary – Résumé en français de la thèse

## 6.1 - Objectif général de la thèse et questions de recherche

La durabilité des systèmes halieutiques doit aujourd'hui être appréhendée de manière multidimensionnelle. Cette thèse discute donc de la durabilité de ces systèmes de manière holistique. En réponse aux objectifs de « systèmes alimentaires durables et sains » portés à l'échelle internationale, une attention particulière est ici portée pour les dimensions environnementales et santé de notre consommation. La dimension environnementale est ici étudiée dans son sens large, de la protection des espèces exploitées à la problématique des émissions de gaz à effet de serre. La dimension santé est-elle abordée au travers du prisme de la sûreté sanitaire des Produits de la Pêche et de l'Aquaculture (PPA), face à des interrogations croissantes des consommateurs. Au-delà de ces deux dimensions spécifiques, ce travail fait aussi le lien entre durabilité du secteur et « production et consommation locales », qui possèdent de fortes implications sur les dynamiques économiques d'un territoire. Les dimensions de bien-être animal et de commerce équitable sont également incluses dans ce travail, car inextricablement liées aux problématiques actuelles des systèmes alimentaires. Ces différentes dimensions de la durabilité sont notamment abordées à travers le prisme des préférences des consommateurs pour les PPA labellisés. En ce sens, cette thèse s'inscrit dans le prolongement de travaux existants, comme celui de Brécard *et al.* (2012), qui ont déjà abordé cette question des préférences des consommateurs pour des labels multiples dans le cadre d'une « consommation durable », en adoptant ici une vision plus englobante.

**L'objectif principal de cette thèse est de proposer des recommandations/leviers pour orienter les consommateurs de PPA vers des comportements de consommation plus durables afin de faire tendre le secteur vers plus de durabilité, avec un regard particulier sur la place des labels pour effectuer cette transition. Le marché de référence utilisé dans cette thèse est le marché français.**

Plusieurs sous-objectifs sont inhérents à cette question de recherche :

- Le premier objectif de cette thèse est d'approfondir la compréhension des habitudes de consommation de PPA en France ;
- Le deuxième objectif de ce travail est de mieux étudier les préférences des consommateurs pour les différents labels pouvant exister sur le marché des PPA ;
- Le troisième objectif de ce travail est de fournir de nouvelles informations sur la valorisation par les consommateurs des initiatives de multi-labellisation dans le secteur PPA.

Pour répondre à ces différents objectifs, cette thèse se structure autour de **quatre articles de recherche**, présentés ci-après.

## 6.2 - Résumé du chapitre 1 : Le rôle des produits de la pêche et de l'aquaculture (PPA) pour répondre à une consommation alimentaire durable

### 6.2.1 - Contexte général

**Le premier chapitre** de cette thèse s'intéresse à comprendre si les comportements de consommation observés sur le marché français des PPA peuvent être considérés comme durables. En effet, promouvoir une consommation vertueuse des PPA semble être un levier intéressant pour atteindre nos objectifs globaux en termes de santé publique (lutter contre certaines maladies de type obésité), mais aussi pour limiter l'impact environnemental de notre consommation alimentaire (en réduisant la consommation de produits carnés). En prenant le marché français comme cas d'étude, cet article vise à mieux étudier l'adéquation des comportements de consommation observés sur ce marché avec les objectifs fixés. Dans un second temps, il identifie des leviers pour faire tendre cette consommation de PPA vers plus de durabilité.

Pour ce faire, cet article mobilise en premier lieu une revue de la littérature qui dresse un panorama des déterminants actuels de la consommation de PPA. L'analyse souligne que les caractéristiques sociodémographiques des consommateurs influencent les comportements observés, notamment l'âge, le revenu, l'éducation, les connaissances, la présence d'enfants dans le ménage et le lieu de résidence (Thong *et al.*, 2017 ; Govzman *et al.*, 2021). Si l'aspect santé des PPA est une motivation historique de la demande (Bimbo *et al.*, 2022), les consommateurs sont aussi attentifs à l'origine des produits. Ils déclarent une préférence pour les PPA locaux (perçus comme de meilleure qualité) face aux produits importés (Uchida *et al.*, 2014). De plus, les ils expriment un intérêt pour des attributs tels qu'une production respectueuse de l'environnement (Lucas *et al.*, 2021) ou un production respectueuse du bien-être animal (Sonntag *et al.*, 2023). De plus, cette analyse met en avant que les produits sauvages sont perçus comme étant de meilleure qualité que les produits d'élevage (Claret *et al.*, 2014, Lopez-Mas *et al.*, 2021). Finalement, des attributs tels que le goût, la fraîcheur, la difficulté de cuisson et le prix déterminent également les comportements de consommation observés (Cantillo *et al.*, 2021).

### 6.2.2 - Données et méthode

Dans un second temps, cet article cherche à comparer les résultats obtenus *via* la littérature avec les comportements de consommation déclarés sur le marché français. Cet article s'appuie sur les résultats d'une enquête de consommation réalisée en 2023 sur le marché français. Cette enquête mobilise des données déclaratives. L'échantillon d'analyse est de 1 895 consommateurs. Pour mesurer l'influence de 20 variables explicatives (identifiées au travers de la revue de la littérature) sur la fréquence de consommation de PPA, un modèle probit ordonné est mobilisé. La variable dépendante mesure la fréquence de consommation des PPA selon trois modalités ordonnées : « au moins une fois par semaine », « au moins une fois par mois » et « moins d'une fois par mois ». Afin de mesurer une différence de perception entre produits sauvages et produits d'élevage, des tests de comparaison de moyennes sont réalisés.

### 6.2.3 - Résultats

Les résultats de notre étude indiquent que, bien que la consommation moyenne française de PPA soit élevée (33kg/an/habitant), cette consommation n'est pas durable (au regard à la fois de l'environnement et des objectifs de santé publique). Elle repose en effet sur un petit nombre d'espèces importées, souvent décriées pour leurs impacts environnementaux. De plus, cette consommation française de PPA n'est pas uniformément répartie au sein de la population. En effet, au moins 54% des consommateurs français consomment des PPA moins d'une fois par semaine, loin des objectifs fixés par l'Agence Nationale de Sécurité Sanitaire de l'Alimentation, de l'Environnement et du Travail (ANSES). Les résultats du modèle probit démontrent que ce sont les consommateurs les plus âgés ayant des revenus élevés qui consomment régulièrement ces produits. Par ailleurs, il existe une corrélation positive entre la consommation régulière de PPA et connaissance objective du secteur par les consommateurs, préférence pour une production artisanale, intérêt pour la fraîcheur de leurs produits et perception des PPA comme étant des produits santé. Ces résultats permettent aussi d'identifier deux freins à la consommation de PPA: la difficulté de cuisiner les PPA et la perception de ces produits comme onéreux. Finalement, nos tests de comparaison de moyennes révélent que les consommateurs ont tendance à percevoir les produits sauvages comme étant de meilleure qualité, notamment sur les aspects santé et de sûreté sanitaire.

### 6.2.4 - Discussion

À la lumière de nos résultats, cet article présente une série de recommandations pour guider les consommateurs français vers une consommation plus « saine et durable » de PPA. Premièrement, cet article défend l'idée que les PPA soient mieux intégrés dans les politiques publiques alimentaires de demain. Leur inclusion est une étape essentielle vers une transition durable du secteur. Deuxièmement, les politiques alimentaires doivent davantage tenir compte de la diversité des PPA. En effet, les PPA sont souvent abordés comme un ensemble homogène. Cependant, ils englobent un large éventail d'espèces et de produits, présentants des attributs sanitaires et environnementaux spécifiques (Gephart *et al.*, 2021 ; Koehn *et al.*, 2022). Cette diversité de produits offre des opportunités intéressantes pour promouvoir des comportements de consommation plus vertueux.

Diversifier la consommation vers des espèces domestiques « sous-utilisées » (Koehn *et al.*, 2020) est présenté comme essentiel. La promotion de ces espèces, notamment au détriment des espèces de grande consommation, peut mener à des bénéfices environnementaux (moins de transport, régime de gestion plus transparent, réduction de la pression sur certains stocks), une baisse des prix pour les consommateurs, ainsi qu'apporter une réponse à la consommation toujours croissante de PPA transformés. En outre, promouvoir des espèces locales peut contribuer à soutenir financièrement une filière affaiblie par les récentes crises qui ont impacté le secteur. Cependant, favoriser la consommation de ces espèces « sous-utilisées » n'est pas une solution miracle, et peut engendrer des externalités négatives (surexploitation, méfiance des consommateurs, etc.) qui doivent être intégrées par les pouvoirs publics.

De plus, nos résultats montrent qu'il est crucial de considérer la dichotomie entre produits sauvages et produits d'élevage afin de promouvoir des comportements plus durables. Les consommateurs ont notamment tendance à percevoir les produits aquacoles comme moins sûrs et santé que les produits sauvages. La promotion de méthodes de productions aquacoles peu intensives peut être une solution pour faire face à ces inquiétudes exprimées par les consommateurs. Finalement, le prix semble aussi être un frein important à la consommation de PPA. Pour surmonter ce problème, comme discuté, la promotion d'espèces locales peut-être une solution, avec des espèces moins coûteuses que les espèces de grande consommation majoritairement importées. De plus, les données de marché disponibles montrent un écart important entre prix moyen au débarquement et prix moyen de vente aux consommateurs (FranceAgriMer, 2023a). Un effort sur la marge de certains acteurs pourrait rendre les PPA plus accessibles aux consommateurs français.

La deuxième partie de la discussion est axée sur la nécessité d'améliorer l'information des consommateurs afin de faciliter l'adoption de comportements plus vertueux. Dans un premier temps, la nécessité d'intégrer les considérations environnementales dans les recommandations alimentaires existantes est discutée (sur l'exemple des pays nordiques). L'intérêt des recommandations du Lancet (Willett *et al.*, 2019), qui intègrent des critères environnementaux dans leurs recommandations nutritionnelles, est aussi mise en avant. Le respect de ces recommandations entraînerait, par exemple, une réduction de la consommation moyenne de PPA d'environ 10 kg par habitant par an en France. De plus, si les campagnes d'information sont aujourd'hui largement utilisées pour promouvoir la consommation de PPA à l'échelle de l'Union Européenne (UE), ces campagnes doivent aussi intégrer plus explicitement des considérations environnementales, ce qui fait largement défaut aujourd'hui. Enfin, les cantines scolaires sont un lieu intéressant pour sensibiliser les jeunes consommateurs à la consommation « durable et saine » des PPA, notamment en les éduquant aux bonnes pratiques et à la consommation de ces espèces « sous-utilisées ».

La dernière section de cet article aborde la question des labels pour guider les consommateurs de PPA et discute de certaines des limites existantes à leur efficacité (Grunert *et al.*, 2014). Afin d'améliorer l'efficacité des démarches existantes et de fournir une information adaptée aux consommateurs, mieux comprendre comment les consommateurs se positionnent par rapport aux différentes démarches de labellisation qui peuvent exister sur le marché des PPA est essentiel. Le rôle potentiel des PPA multi-labellisés pour informer les consommateurs est aussi mis en avant.

## 6.3 - Résumé du Chapitre 2 : Évaluation des préférences des consommateurs dans le contexte de labels multiples: le cas des produits de la pêche et de l'aquaculture

### 6.3.1 - Contexte général

Le **chapitre 2** de cette thèse s'intéresse à mieux comprendre la structure des préférences des consommateurs envers les différents labels qui coexistent sur le marché français des PPA. En effet, ce marché est profondément affecté par la multiplication des labels. Cependant, ces labels s'intéressent souvent à un attribut spécifique du

produit (comme la qualité, son origine, sa méthode de production, le bien-être animal, etc.). En conséquence, les consommateurs sont confrontés à des situations d'arbitrage lors de leurs actes d'achat de PPA labellisés. Cependant, si la littérature existante se concentre souvent sur les préférences exprimées pour un nombre unique ou limité de labels (Brécard *et al.*, 2009 ; Banovic *et al.*, 2019), aucune étude n'a étudié ces préférences pour un éventail élargi de possibilités. Cet article vise à combler ce manque en adoptant une approche à choix multiples, où les consommateurs ont la possibilité d'exprimer leurs préférences envers un large choix de labels. Comprendre comment s'organisent ces préférences est essentiel pour améliorer l'efficacité des démarches de labellisation et guider les consommateurs vers une consommation plus durable des PPA.

**6.3.2 - Données et méthode**

Les données mobilisées dans ce travail proviennent d'une enquête de consommation réalisée en ligne en 2021 sur le marché français. La taille de l'échantillon est de 1 427 consommateurs, représentatifs de la population française. Ces données sont déclaratives. Dans cette enquête, il a été demandé aux consommateurs interrogés de classer leurs trois labels préférés parmi dix alternatives possibles. Ces alternatives ont été choisies sur la base des labels existants sur le marché des PPA, mais aussi au regard des tendances actuelles de consommation dans le secteur alimentaire. Pour cette étude, des labels hypothétiques ont été utilisés afin d'éviter tout biais d'ancrage (FranceAgriMer, 2019).

Concernant la méthode d'analyse, des tests de comparaison de moyennes ont été utilisés pour comparer statistiquement les préférences exprimées par les consommateurs au regard des différentes alternatives proposées.Un modèle logit multinomial mixte (MMNL) à effets marginaux a été mobilisé pour étudier les profils de consommation derrière ces préférences déclarées. Pour les besoins du modèle, seule la première préférence exprimée a été retenue comme variable dépendante. Sur la base de la littérature existante et des travaux antérieurs, onze variables explicatives liées aux caractéristiques sociodémographiques des consommateurs, à leurs motivations, à l'efficacité perçue de leurs choix de consommation et à leurs connaissances personnelles du secteur ont été incluses dans le modèle.

**6.3.3 - Résultats**

Globalement, nous constatons que les préférences des consommateurs français dans une situation de choix multiples sont très hétérogènes. Les résultats montrent qu'environ 18 % des consommateurs français placent les labels de qualité et « Origine France » au premier rang de leurs préférences. Deuxièmement, ils valorisent un groupe de trois labels : les écolabels, les allégations sûreté[41] et les labels d'origine locale (~10 % de l'échantillon), suivis des labels de bien-être animal. Les allégations nutritionnelles, les labels de commerce équitable et les labels d'origine européenne sont moins recherchés. Il est intéressant de noter que 8 % de notre échantillon préfèrent les

[41] Dans le sens où le PPA considéré ne contient aucune substance dangereuse pour le corp humain, comme définit dans le cadre de nos travaux.

PPA sans label.

Les résultats du modèle logit fournissent des informations intéressantes sur les profils de consommation inhérents aux préférences exprimées. Les motivations influencent les préférences observées. Les consommateurs ayant un haut degré d'universalisme sont plus susceptibles de valoriser les labels éthiques (écolabels et labels de bien-être animal) et moins susceptibles de valoriser les labels « origine France » et l'alternative « Sans label ». Ceux qui s'intéressent à l'origine de leurs PPA sont eux plus susceptibles de rechercher des labels liés à l'origine de leur produit tels que les labels « origine France » et les labels « origine locale ». Enfin, l'attachement à des valeurs traditionnelles accroît la préférence pour les labels « origine France » et diminue la préférence pour les labels « origine locale » et les écolabels.

Nos résultats démontrent également que l'âge est un facteur important de ces préférences. Les consommateurs jeunes ont tendance à préférer les écolabels et les labels de bien-être animal, tandis que les consommateurs plus âgés préfèrent les allégations sûreté et les labels « origine France ». Les femmes accordent elles davantage d'importance aux allégations sûreté et aux étiquettes de bien-être animal que les hommes. Le lieu de résidence est également un facteur déterminant, les habitants du littoral étant plus susceptibles de préférer les labels « origine locale » et moins susceptibles de valoriser les écolabels et les labels d'origine France.

**6.3.4 - Discussion**

Sur la base de ces différents résultats, nous essayons d'identifier des leviers pour inciter les consommateurs à adopter des comportements plus durables. Nos résultats démontrent une forte préférence des consommateurs français pour des PPA domestiques (labels « origine locale » et « origine France »). Cette préférence présente de nombreux avantages en termes de durabilité (soutien à une filière nationale fragilisée, souveraineté alimentaire et bénéfices environnementaux par rapport aux espèces importées) qui peuvent être exploités pour promouvoir des comportements plus vertueux. Cependant, localité n'est pas forcément synonyme de durabilité, et il convient donc de lier ces deux dimensions avec précaution.

Nos résultats démontrent que dans une situation à choix multiples, les préférences des consommateurs sont principalement motivées par des motivations égoïstes, comme discuté par Sonntag *et al.* (2023). En effet, ils ont tendance à préférer des labels qui garantissent une qualité supérieure des produits à ceux orientés vers le bien-être social. Les préférences pour les écolabels et les labels de bien-être animal restent en effet secondaires. Afin d'atteindre les objectifs fixés dans la stratégie environnementale de l'Union Européenne (Green Deal), il est nécessaire de renforcer cette demande pour ces labels éthiques, et notamment en ce qui concerne les écolabels. Informer et rassurer les consommateurs sur la pertinence de ces approches semble une étape essentielle pour motiver cette demande, spécifiquement dans un contexte de méfiance croissante (Giacomarra *et al.*, 2021). Les jeunes générations, qui se positionnent plus fortement que leurs aînés vis-à-vis de ces écolabels, doivent faire l'objet d'une attention particulière de la part des politiques publiques qui cherchent à mettre en avant une consommation verte des PPA. Leur profil est d'autant plus intéressant qu'ils constituent les consommateurs de

demain.

Si les politiques alimentaires actuelles, notamment en matière de labellisation, ne parviennent pas à promouvoir une consommation durable des PPA, nous recommandons qu'elles prennent davantage en compte la diversité des profils de consommation ainsi que la diversité des attentes exprimées par ces consommateurs. En effet, les politiques existantes se caractérisent par une rigidité et un manque d'adaptabilité, ce qui freine leur adoption par une population présentée comme très hétérogène. Mieux adapter les initiatives en fonction de la population cible semble donc essentiel. Promouvoir des garanties sur les aspects environnementaux des PPA semble être une stratégie efficace pour toucher les jeunes consommateurs. Mettre en avant la dimension locale du produit peut être utile pour mieux impliquer les populations côtières. En effet, les labels « origine locale » peuvent être utilisés comme proxy de plusieurs attributs des PPA par ces ménages (Feldmann et Hamm, 2015). À l'inverse, promouvoir des approches de type écolabels auprès de ces ménages pourrait avoir un potentiel plus limité, dans la mesure où les consommateurs côtiers peuvent avoir tendance à percevoir ces labels comme une menace pour les activités traditionnelles du territoire (Salladarré *et al.*, 2010). Nos résultats suggèrent que d'autres caractéristiques, comme le genre ou la présence d'enfants dans le ménage, peuvent être des facteurs à prendre en compte pour implémenter des politiques de labellisation plus efficaces et faire tendre nos modes de consommation vers plus de durabilité.

## 6.4 - Résumé du chapitre 3: L'effet de la méthode de production sur le CAP des consommateurs pour des produits de la mer avec un label unique et un double label

### 6.4.1 - Contexte général

Le troisième chapitre de cette thèse est dédié à l'étude du consentement à payer (CAP) des consommateurs envers les écolabels, les allégations de sûreté et leur association potentielle sur un même PPA. En effet, la multi-labellisation peut permettre de répondre aux attentes de consommation hétérogènes discutées précédemment (**Chapitre 2**). Dans le contexte de ce travail, nous avons choisi de travailler spécifiquement sur ces deux labels car ils sont à la fois liés au contexte global d'une alimentation « durable et saine » et répondent à deux *drivers* importants de la consommation des PPA: la dimension de santé et la dimension environnementale.

Si les produits alimentaires avec plusieurs labels sont de plus en plus courants sur le marché alimentaire (Dufeu *et al.*, 2014), il n'existe pas de consensus global dans la littérature sur l'impact de cette multi-labellisation au regard de l'utilité et du CAP des consommateurs. De plus, cette littérature reste limitée dans le secteur des PPA. Les recherches existantes se limitent souvent à l'interaction entre un label unique et les attributs intrinsèques d'un PPA (espèce, mode de conservation, prix, etc.). Dans notre cas, nous voulons mesurer l'interaction entre deux labels et ces attributs intrinsèques. Nous cherchons notamment à mesurer un effet « méthode de production » sur les CAP déclarés. En effet, des recherches antérieures ont démontré que les consommateurs ont des perceptions différentes des produits sauvages et d'élevage (**Chapitre 1**), et qu'ils ont tendance à associer les

préoccupations environnementales aux espèces sauvages et les préoccupations sanitaires aux espèces d'élevage (Zander et Feucht, 2018). Au travers de ce travail, nous cherchons donc à mesurer si ces perceptions différenciées peuvent venir influencer les préférences des consommateurs et leur CAP au regard des deux labels inclus dans ce travail. Globalement, cet article vise à tester trois hypothèses : {**H1**} Le CAP déclaré dépend des caractéristiques socio-démographiques des individus ; {**H2**} La méthode de production influence le CAP déclaré ; {**H3**} : Le CAP des consommateurs pour un PPA double-labellisé est supérieur au CAP pour un PPA avec un label unique, mais le CAP marginal est décroissant.

### 6.4.2 - Données et méthode

Pour tester ces hypothèses de recherche, cet article s'appuie sur les résultats d'une enquête de consommation en ligne réalisée en 2023 sur le marché français. Notre échantillon est composé de 1 895 consommateurs. Pour mesurer le CAP de nos consommateurs, nous avons mobilisé la méthode de la « double enchère ». *Via* cette méthode, les consommateurs sont invités à se positionner par « Oui» ou « Non » au regard de deux enchères. La valeur prise par la seconde enchère est ici déterminée par la réponse apportée à la première enchère. Une option de sortie est possible. Pour étudier les profils de consommation derrière ces CAP déclarés, ce travail mobilise un modèle probit à effets aléatoires. En effet, puisque nous disposons de données en pseudo-panel, la probabilité que nos consommateurs répondent « Oui » aux enchères peut être estimée *via* ce modèle (Salladarré *et al.*, 2016). Notre modèle comprend 21 variables explicatives liées au prix perçu des PPA, aux connaissances du secteur, aux motivations à l'achat, à l'efficacité perçue des choix de consommation, à l'âge du consommateur, au genre du consommateur, à son département de résidence, à ses revenus ainsi qu'à la mesure de deux biais liés à la méthode employée. Pour tester l'effet de la « méthode de production » sur le CAP des consommateurs, deux espèces spécifiques sont proposées dans nos enchères: le cabillaud (une espèce sauvage) et le saumon (une espèce d'élevage). Ces deux espèces ont été choisies en raison de leur importance dans la consommation française de PPA (FranceAgriMer, 2023a).

### 6.4.3 - Résultats

Notre hypothèse {**H1**} est confirmée par les résultats du modèle probit. On retrouve notamment un effet revenu pour les allégations de sûreté, mais pas pour les écolabels. Pour les PPA doublement labellisés, on constate que les consommateurs ayant un revenu supérieur à 2 800 € ont un CAP plus élevé que les autres, mais uniquement pour le saumon. On retrouve aussi l'influence des motivations des consommateurs. Faire preuve d'un haut degré d'universalisme influence négativement le CAP pour le cabillaud écolabellisé, ce qui est assez surprenant au regard de la littérature. De plus, l'attachement à la tradition est négativement corrélé au CAP pour le cabillaud écolabellisé, là où l'attachement du consommateur aux questions santé est associé à un CAP plus élevé. Il est intéressant de noter que l'efficacité perçue des choix de consommation réduit globalement le CAP du consommateur, pour tous les labels testés et toutes les espèces. Cela tend à souligner une méfiance générale de ces consommateurs à l'égard des initiatives de labellisation. Parmi les variables sociodémographiques, l'âge

influence aussi le CAP des consommateurs. Les générations les plus âgées ont en effet un CAP réduit pour le cabillaud écolabellisé vis-à-vis de la génération des 18-34. De plus, les personnes de plus de 50 ans ont tendance à avoir un CAP inférieur à celui des jeunes consommateurs pour les PPA doublement labellisés (avec une exception pour le saumon pour les plus de 65 ans). Certaines autres variables (sexe, connaissances) présentes dans le modèle ont une influence plus limitée sur les CAP déclarés. Concernant les deux biais inclus dans notre modèle, nous retrouvons à la fois le biais d'ancrage et le biais « Oui/Oui ». L'inclusion de ces biais permet d'affiner nos estimations du CAP. Il est intéressant de noter qu'il existe certaines contradictions lorsque l'on compare ces résultats avec ceux du **Chapitre 2**, qui étaient basés uniquement sur les préférences déclarées. Cet écart peut s'expliquer par l'introduction d'une contrainte budgétaire dans cet article qui n'était pas présente dans les travaux précédents.

Nos résultats démontrent que l'ajout d'un label unique sur un PPA augmente le CAP des consommateurs. Dans l'ensemble, les consommateurs ont tendance à mieux valoriser les allégations de sûreté (+ 1,63 € par kilo) que les écolabels (+ 1,56 € par kilo). Ce résultat suggère les consommateurs ont tendance à valoriser plus fortement les informations leur assurant directement un bénéfice personnel (en lien avec les résultats du **chapitre 2**). Si on se concentre uniquement sur le saumon, les allégations sûreté conduisent à un CAP plus élevé (+1,81 € par kilo) que les écolabels (+1,52 € par kilo), tandis que pour le cabillaud, les écolabels ont un impact plus important (+1,60 € par kilo) que les allégations sûreté (+1,45 € par kilo) sur le CAP des consommateurs. Cela conforte l'hypothèse selon laquelle la méthode de production peut influencer le CAP des consommateurs {**H2**}. En effet, comme attendu, les consommateurs ont tendance à mieux valoriser les allégations de sûreté sur les espèces d'élevage et les labels environnementaux sur les espèces sauvages. Leurs perceptions des deux méthodes de production (**Chapitre 1**) et leurs attentes différenciées entre « aquaculture durable » et « pêche durable » (Zander et Feucht, 2018) peuvent expliquer cette tendance.

Finalement, nos résultats confirment partiellement notre hypothèse {**H3**}. En effet, ils démontrent que le CAP marginal du consommateur pour l'apposition d'un second label sur un PPA dépend du premier label présent sur ce produit. Si ce premier label fournit une information sur l'attribut que le consommateur valorise le plus au regard de la méthode de production (informations environnementales pour les espèces sauvages et informations de sûreté pour les espèces d'élevage), l'ajout d'un deuxième label entraîne un CAP marginal négatif. Par exemple, le CAP moyen pour le saumon avec deux labels est de + 1,68 € par kg, ce qui est inférieur au CAP moyen pour un saumon avec une allégation sûreté unique (+ 1,81 € par kg). L'inverse est aussi vérifié pour le cabillaud et les écolabels. Le CAP moyen du cabillaud avec deux labels est de +1,55 € par kilo, ce qui est inférieur au CAP moyen d'un cabillaud avec un écolabel unique (+1,60 € par kilo).

### 6.4.4 - Discussion

La discussion porte sur la nécessité de promouvoir des modes de production plus respectueux de l'environnement pour les espèces sauvages et de nouvelles formes d'aquaculture moins intensives en intrants pour

les espèces aquacoles, afin de rassurer les consommateurs vis-à-vis de leurs inqiétudes au regard de ces deux modes de production, captées ici au travers de leur CAP. De plus, si le secteur aquacole européen veut devenir plus compétitif, comme affiché *via* la stratégie européenne pour une aquaculture durable, rassurer les consommateurs sur les aspects sanitaires de sa production est essentiel. Dans ce sens, nos résultats démontrent qu'une meilleure communication des producteurs aquacoles sur les critères sanitaires inclus dans les écolabels aquacoles peut être une solution pour accroître l'acceptation et la valorisation de ces produits auprès des consommateurs.

Dans le cas des espèces sauvages, les consommateurs ont un CAP élevé pour les écolabels. Cependant, avec le nombre croissant d'écolabels sur le marché (Lucas *et al.*, 2021), et l'entrée de labels « douteux » sur le marché, on observe un niveau de méfiance croissant des consommateurs. Cette tendance tend à limiter le pouvoir des écolabels « vertueux » à changer durablement le comportement des consommateurs. Un cadre législatif plus strict pour réguler à la fois la prolifération de ces écolabels, mais aussi l'entrée de ces labels douteux sur le marché est nécessaire pour permettre aux écolabels venir modifier durablement les comportements de consommation. En ce qui concerne le CAP positif des consommateurs pour les allégations sûreté concernant les espèces sauvages, cela témoigne d'un intérêt grandissant des consommateurs pour les aspects sanitaires des espèces sauvages, qui jusqu'à présent possédaient une image de produit sain auprès des consommateurs. Globalement, ces résultats tendent à plaider en faveur d'une meilleure prise en compte des modes de production dans les politiques alimentaires publiques concernant les PPA.

Finalement, il convient de discuter de la question de la multi-labellisation dans le secteur. Nos résultats suggèrent qu'un label unique peut conduire à un CAP plus élevé de la part des consommateurs qu'un PPA avec un double-label. Cet effet se produit lorsque le premier label apposé sur le produit fournit une information sur l'attribut le plus valorisé par le consommateur (par exemple, les écolabels pour les espèces sauvages et les allégations de sûreté pour les espèces d'élevage) et que le deuxième label ajouté est relatif à un attribut plus secondaire. Les consommateurs atteignent un « niveau optimal » d'information en présence de ce label unique (Bougherara *et al.*, 2007), qui est perçu par les consommateurs comme plus efficace que des labels combinés (Sirieix *et al.*, 2013, Fonner et Sylvia, 2015). Ce résultat souligne la complexité pour les producteurs de communiquer aux consommateurs sur de multiples attributs de crédence ainsi que l'intérêt de communiquer sur le bon label plutôt que de chercher à communiquer au travers de labels multiples.

Toutefois, malgré ces résultats, les PPA avec deux labels ont un potentiel intéressant pour guider les consommateurs vers des choix de consommation plus durables. Nous discutons de leviers pour augmenter l'acceptation de telles démarches, notamment auprès des consommateurs les plus âgés qui, bien qu'ils soient des consommateurs réguliers de PPA, semblent moins enclins à valoriser ces approches. Premièrement, il est nécessaire d'informer et d'éduquer les consommateurs de manière transparente sur ces approches. En effet, la connaissance est un facteur essentiel pour l'adoption de nouveaux comportements. De plus, il convient d'associer

des labels qui sont perçus comme complémentaires par les consommateurs. Finalement, comme discuté par Janssen et Hamm (2012), le succès de ces produits à multiples labels dépend du fait que les consommateurs reconnaissent au moins un label comme « digne de confiance », notamment dans un contexte de méfiance croissante à l'égard de ces initiatives. Dans cette optique, l'utilisation de labels certifiés par les autorités publiques peut accroître l'acceptation de ces démarches.

## 6.5 - Résumé chapitre 4: La place des consommateurs dans les dynamiques territoriales de connaissance : le cas des produits de la mer

### 6.5.1 - Contexte général

Le **quatrième chapitre** de cette thèse est plus original dans son approche, combinant deux branches de l'économie : l'économie de la consommation et les sciences régionales. Cet article propose une nouvelle interprétation du concept de dynamique territoriale de connaissance en incluant les consommateurs dans le triptyque industrie, recherche et administration. La négligence du rôle des consommateurs dans ces dynamiques a été soulignée par Crevoisier et Jeannerat (2009) et abordée dans des travaux plus récents (Jeannerat et Kebir, 2015 ; Martin *et al.*, 2019). Pour répondre à cette problématique, nous avons décidé de concentrer nos travaux sur l'industrie des PPA, une industrie qui peut être perçue comme peu innovante et peu fondée sur la connaissance. Dans cet article, nous cherchons à répondre à ces deux questions spécifiques : l'industrie PPA répond-elle aux caractéristiques d'une économie basée sur la connaissance ? Cette connaissance est-elle partagée avec les consommateurs ?

La première section est consacrée à l'explication des modèles d'interaction entre producteurs et consommateurs, avec une référence particulière aux travaux de Grabher, Ibert et Flohr (2008), Jeannerat et Kebir (2015) et Martin, Martin et Zukauskaite (2019). La deuxième section de cette étude vise à examiner dans quelle mesure l'industrie des PPA répond aux caractéristiques d'une économie basée sur la connaissance. Nous soutenons que les centres de production, tels que les criées, peuvent faciliter la formation de dynamiques territoriales de connaissance, notamment en raison de leur proximité géographique avec les consommateurs littoraux. Les consommateurs des zones côtières peuvent ainsi jouer un rôle clé dans la diffusion des connaissances, notamment tacites. Leur contribution réside avant tout dans l'appropriation des connaissances plutôt que dans la transformation et la création de connaissances.

### 6.5.2 - Données et méthode

Sur la base de ces observations, nous utilisons les résultats d'une enquête auprès des consommateurs pour tester empiriquement si la proximité des centres de production peut influencer la connaissance du secteur par les consommateurs et, indirectement, leurs préférences pour les PPA labellisés. Cette enquête a été réalisée en 2021 sur le marché français. La taille de l'échantillon est de 1 233 personnes. Pour les besoins de ce travail, cet échantillon a été divisé en deux sous-échantillons : les consommateurs côtiers et les consommateurs non-côtiers. Le département d'habitation sert ici de référence. Deux analyses statistiques différentes sont ensuite réalisées pour

tester nos hypothèses. Tout d'abord, un test de comparaison des moyennes, pour vérifier les écarts entre les deux sous-échantillons dans leurs préférences déclarées en matière de PPA. Deuxièmement, un modèle Logit Multinomial (MNL), pour évaluer l'impact des caractéristiques des deux sous-échantillons sur leurs préférences déclarées pour neuf labels et une alternative « Sans label ». Ce modèle intègre vingt-deux variables explicatives, dont quatre variables liées aux connaissances (objectives, subjectives, labels et liées aux espèces), centrales dans ce travail. Enfin, à la lumière des résultats limités obtenus *via* ce MNL, un deuxième test de comparaison des moyennes a été réalisé pour tester l'écart potentiel de connaissances entre nos deux échantillons vis-à-vis de la filière des PPA.

**6.5.3 - Résultats**

Nos résultats mettent en évidence que nos deux sous-échantillons ont des préférences différenciées concernant les PPA. Les consommateurs côtiers ont tendance à avoir une préférence plus élevée pour les PPA « dont la méthode de production a un faible impact environnemental ». Par ailleurs, ils manifestent également un plus grand intérêt pour les PPA issus dans leur région et les PPA d'origine française. Par la suite, les résultats des préférences exprimées pour trois labels, à savoir « Origine locale », « Origine France » et « Ecolabel » sont discutés. L'analyse se concentre spécifiquement sur ces trois labels car ils sont directement liés aux préférences pour les PPA qui distinguent nos deux sous-échantillons. Si notre MNL renseigne sur l'influence de plusieurs variables sur ces préférences déclarées, il n'y a pas de différence significative entre nos deux échantillons en termes d'influence des variables de connaissance, à deux exceptions près. Premièrement, la possession d'une connaissance objective du secteur accroît la préférence des résidents côtiers pour le label « origine locale ». Deuxièmement, la possession d'une connaissance « spécifique aux labels » accroît la préférence pour les écolabels parmi les résidents non-côtiers. Un deuxième test de comparaison de moyennes est ensuite réalisé pour évaluer plus précisément l'écart potentiel de connaissances du secteur des PPA entre nos deux sous-échantillons. Les résultats indiquent que les individus résidant dans les zones côtières ont tendance à se percevoir comme plus experts du secteur (connaissance subjective) que les ménages non-côtiers. De plus, ils possèdent une connaissance objective supérieure. En effet, les consommateurs littoraux sont plus au fait de la réglementation obligatoire concernant les PPA vendus frais au sein du marché européen depuis 2013. Par ailleurs, ils sont plus susceptibles d'être conscients de l'utilisation de l'huile de poisson et de la farine de poisson comme source d'alimentation animale pour les productions aquacoles. Ces résultats démontrent que les consommateurs résidant dans les zones côtières ont tendance à avoir une connaissance plus précise du secteur des PPA que ceux résidant dans les zones non côtières.

**6.5.4 - Discussion**

L'industrie PPA présente-t-elle les caractéristiques d'une économie basée sur la connaissance ? Au sens étroit de dynamique des connaissances territoriales, la réponse semble affirmative. En effet, les percées technologiques et les innovations progressives sont évidentes dans le secteur, notamment en ce qui concerne les

processus de commercialisation. Nos résultats indiquent aussi que les connaissances sont plus largement partagées dans les zones côtières que dans les régions plus reculées. Les consommateurs côtiers semblent plus familiers avec les enjeux environnementaux liés à ce secteur et probablement avec les controverses autour des écolabels, ce qui peut aussi venir expliquer pourquoi ils se méfient de ces démarches (**Chapitre 2**). Ils possèdent également une expertise supérieure sur les « questions techniques » concernant le secteur des PPA. Par conséquent, le rôle des consommateurs dans une dynamique régionale de la connaissance ne peut être sous-estimé. Ce travail démontre que l'industrie PPA génère de nouvelles connaissances qui ne sont pas encore suffisamment diffusées auprès des consommateurs de manière accessible et compréhensible, notamment au regard de la réglementation en place depuis 2013. L'éloignement géographique entre les zones de production semble se traduire par une asymétrie d'information entre les consommateurs situés dans les zones côtières et non côtières. Il est donc essentiel de limiter cette information asymétrique envers les habitants des départements non côtiers afin de les orienter vers une consommation plus durable des PPA.

## 6.6 - Conclusion générale de la thèse

L'objectif général de cette thèse est de fournir des recommandations aux décideurs publics afin de promouvoir une consommation durable des PPA, en se concentrant notamment sur le rôle informatif des labels. Dans un premier temps, ce travail cherche à mieux comprendre la cohérence entre habitudes de consommation sur le marché français des PPA et les objectifs d'une consommation alimentaire « saine et durable » (**Chapitre 1**). Face à une consommation moyenne de PPA élevée (33kg/habitant en 2021), ce travail met en évidence le caractère non durable de la consommation française. Pour faire tendre cette consommation vers plus de durabilité, cette thèse soutient l'idée d'une intégration plus franche des PPA dans les politiques alimentaires publiques existantes, au même titre que la viande, les fruits et les légumes. Cela constitue une première étape essentielle pour faire tendre nos habitudes de consommation vers plus de durabilité.

Afin de promouvoir une consommation durable des PPA auprès des consommateurs, il est nécessaire de mieux les informer, notamment au regard des espèces dont les modes de production répondent aux objectifs environnementaux et de conservation des ressources (**Chapitre 1**). Cela implique d'intégrer la dimension environnementale dans les initiatives visant à promouvoir la consommation des PPA (type recommandations nutritionnelles ou campagnes informationnelles). De plus, si les écolabels ne constituent pas un critère de choix premier pour les consommateurs (**Chapitre 2**), il est nécessaire de motiver cette demande pour poursuivre les objectifs de préservation de la ressource fixés à l'échelle communautaire. Pour ce faire, accroitre l'information et l'éducation des consommateurs vis-à-vis de ces démarches dans un contexte global de méfiance grandissante semble essentiel. Nos résultats démontrent en effet que la connaissance des consommateurs sur les questions environnementales est limitée, en particulier parmi les ménages non côtiers (**Chapitre 4**). Une meilleure appréhension de ces enjeux pourrait inciter les consommateurs à adopter une position plus affirmée en faveur de ces écolabels. La mise en place d'un cadre législatif plus contraignant doit aussi permettre de rassurer les

consommateurs face à la multiplication de ces démarches sur le marché des PPA.

Les résultats démontrent aussi l'importance de mieux prendre en compte l'hétérogénéité des consommateurs pour implanter des démarches de labellisation plus efficaces. En effet, les attentes des consommateurs français en matière de PPA labellisés sont très hétérogènes (**Chapitre 2**). Cette hétérogénéité met en évidence la difficulté de mettre en œuvre une politique publique d'information (et de labellisation) qui réponde à toutes les attentes exprimées par les consommateurs concernant les PPA. Un message adapté en fonction du public cible peut s'avérer plus efficace que des approches parfois trop généralistes.

Nos travaux démontrent aussi l'importance de prendre en compte l'existence des deux méthodes de production dans les politiques publiques alimentaires. Si, au niveau de la production, il existe une distinction entre les politiques publiques orientées vers la pêche et les politiques publiques orientées vers l'aquaculture, ce n'est pas encore le cas au niveau de la consommation. Les PPA sont notamment traités comme un ensemble homogène, malgré une diversité importante des produits et des espèces. Cependant, les consommateurs ont des attentes différentes concernant ces deux types de produits (**Chapitres 1 & 3**). En général, ils perçoivent les produits sauvages comme étant de meilleure qualité que les produits aquacoles, notamment au regard de leurs attributs santé et de sûreté sanitaire (**Chapitre 1**). Cela se traduit au niveau du CAP des consommateurs, qui ont tendance à fortement valoriser les allégations sûreté sur les espèces aquacoles (**Chapitre 3**). Rassurer les consommateurs sur ces aspects sanitaires semble crucial pour développer l'aquaculture européenne en tant que source alimentaire durable et à faibles émissions carbone. Les dimensions environnementales des productions aquacoles sont aussi d'intérêt pour les consommateurs. Au regard des produits sauvages, les consommateurs expriment un CAP élevé pour les écolabels, soulignant leur sensibilisation aux enjeux environnementaux liés à la pêche, bien que nos résultats tendent à confirmer une préoccupation croissante quant aux risques sanitaires liés à la pollution marine, avec un CAP significatif pour les allégations sûreté (**Chapitre 3**).

Cette thèse aborde aussi la question de la diversification de la consommation comme un facteur important pour faire tendre les comportements de consommation vers plus de durabilité. En effet, il semble nécessaire de substituer les espèces de forte consommation, principalement importées, par des espèces sous-utilisées et produites plus localement (**Chapitre 1**). Du point de vue de la durabilité, favoriser la consommation d'espèces domestiques présente plusieurs avantages, notamment environnementaux. D'un point de vue économique, la valorisation de ces espèces domestiques peut aussi permettre de soutenir un secteur fragilisé par les récentes crises. Cette thèse démontre que consommer plus local peut être une solution à la barrière du prix et à la consommation croissante de PPA transformés. De manière intéressante, nos enquêtes démontrent un intérêt des consommateurs français pour l'origine domestique des PPA qu'ils consomment (**Chapitre 2**). Dans une situation de choix multiples, les consommateurs expriment en effet une préférence marquée pour les labels « origine France » et « origine locale ». Développer le recours à ces labels peut encourager à la consommation d'espèces domestiques. Toutefois, les attributs locaux ne doivent pas remplacer les attributs environnementaux. Il convient

donc d'intégrer des considérations environnementales contraignantes à ces démarches.

Pour parvenir à une consommation plus durable des PPA en France, la proximité de la mer doit être mieux intégrée du point de vue des consommateurs. La consommation de PPA est plus élevée dans les zones côtières que dans les régions plus reculées, mettant en évidence l'influence du lieu de résidence sur le comportement alimentaire (**Chapitres 2 & 4**). Ce travail démontre que les ménages résidant dans un département côtier ont des préférences : 1) pour les PPA originaires de leur territoire ; 2) pour les labels associés. Par ailleurs, ces ménages côtiers, s'ils expriment une préférence pour les PPA produits selon des méthodes à faible impact environnemental, expriment une moindre préférence pour les écolabels. Selon Salladarré *et al.* (2010), ces écolabels peuvent être perçus comme remettant en cause les activités de pêche se déroulant sur le territoire. Cette thèse discute également de l'impact des controverses autour des écolabels qui peuvent venir influencer les préférences des consommateurs côtiers (**Chapitre 4**), qui connaissent mieux le secteur que ceux vivant plus à l'intérieur des terres. Afin de favoriser une consommation durable des PPA dans ces zones côtières, les labels « origine locale » semblent donc mieux adaptés aux attentes des consommateurs côtiers que les écolabels (**Chapitre 2**). Les initiatives existantes sur le marché français soutiennent ce résultat. Cependant, comme indiqué précédemment, le caractère local n'est pas nécessairement synonyme de durabilité environnementale. Il est donc essentiel de lier ces deux dimensions de manière explicite.

Dans un contexte global de réforme des systèmes alimentaires « santé et environnement », cette thèse s'intéresse à l'association potentielle d'un écolabel et d'une allégation de sûreté sanitaire sur un même produit (**Chapitre 3**). En effet, apposer plusieurs labels sur un produit peut permettre de répondre aux préférences hétérogènes exprimées par les consommateurs (**Chapitre 2**). Si les travaux sur la multi-labellisation sont rares dans le secteur des PPA, ce travail fournit des éléments de discussion intéressants. Il met notamment en évidence que les consommateurs ont un CAP plus élevé pour les PPA avec un label unique que pour les PPA avec deux labels lorsque ce label unique est lié à l'attribut le plus valorisé par les consommateurs au regard de la méthode de production (attribut environnemental pour les produits de la pêche et attribut sanitaire pour les produits aquacoles). Dans ce cas, l'ajout d'informations supplémentaires *via* un second label est perçu comme du « bruit » par le consommateur, conduisant à un CAP marginal négatif. Pour les producteurs, cela démontre l'intérêt de communiquer *via* un label unique plutôt que de tenter d'ajouter trop de labels à leurs produits. Ce résultat démontre aussi l'intérêt pour les producteurs aquacoles qui répondent déjà aux spécifications d'un écolabel, comme le label biologique, à mieux informer les consommateurs sur l'existence de critères sanitaires inhérents à ce label afin d'augmenter la valeur de leur production.

Même si la double labellisation peut être un levier potentiel pour répondre à la diversité des préférences exprimées par les consommateurs, il est nécessaire de les rassurer sur l'efficacité potentielle de ces approches. En effet, nos résultats montrent que les consommateurs plus âgés, qui sont des consommateurs réguliers de PPA, peuvent être sceptiques quant à ces approches, avec un CAP limité pour ces démarches. Cet article discute des

leviers potentiels pour accroître l'acceptation par les consommateurs de PPA doublement labellisés. Il faut, par exemple, éviter d'associer des labels perçus comme non complémentaires par ces consommateurs. En outre, le recours à des labels perçus par les consommateurs comme fiables et dignes de confiance peut également s'avérer efficace. À cet égard, les labels des institutions publiques offrent des opportunités.

Les résultats présentés dans cette thèse peuvent souffrir de plusieurs limites. Nos résultats sont basés sur des données déclaratives. Il est donc difficile, à la lumière des connaissances actuelles, de savoir si ces comportements déclarés se traduisent par des comportements d'achat réels. Cet écart comportemental est commun dans la littérature qui s'intéresse aux préférences déclarées (Young *et al.* 2010). De plus, tous les labels présentés aux consommateurs sont des labels hypothétiques, ce qui peut venir modifier les préférences déclarées. Enfin, les considérations sociales restent marginalement discutées dans ce travail. Bien qu'elles soient essentielles au regard de la notion de durabilité, elles restent secondaires du point de vue des attentes des consommateurs et sont ici marginalement intégrées aux différentes recommandations proposées.

Cette thèse permet également de discuter des besoins de recherche pour orienter avec succès les consommateurs vers une consommation plus durable des PPA, notamment en ce qui concerne les labels. Premièrement, il existe un réel besoin de données sur les labels au niveau des entreprises et des points de vente. Ces données d'achat sont essentielles pour obtenir une image plus complète de la place des labels dans le secteur. Cependant, ces données restent très limitées dans le secteur des PPA. Bien que la question de la multi-labellisation soit abordée dans cette thèse, elle mérite encore d'être discutée dans le futur. Une piste intéressante pourrait être d'essayer de mesurer l'influence des organismes de certification (public vs. privé) sur l'acceptation de ces approches. Dans le même ordre d'idées, la réalisation de recherches en économie comportementale peut servir à améliorer l'adoption de ces produits par les consommateurs. Compte tenu des préférences exprimées par les consommateurs pour les PPA labellisés sur le marché français, il peut également être intéressant d'étudier l'association entre un label d'origine et un écolabel, notamment dans les zones côtières. Les résultats discutés dans cette thèse soulèvent également la question de la place d'un label métal dans le secteur des PPA (un label qui comprend un large ensemble de critères liés aux questions de durabilité), comme discuté par Sonntag *et al.* (2023). En effet, ce label pourrait être une réponse aux limites rencontrées actuellement par les labels, notamment en ce qui concerne les questions d'hétérogénéité des préférences et de la surcharge informationnelle. Cependant, la faisabilité d'un tel label reste ouverte à débat, d'autant plus que le concept de durabilité lui-même reste finalement mal défini.

## 6.7 - References

**Banovic, M., Reinders, M. J., Claret, A., Guerrero, L., & Krystallis, A.** (2019). A cross-cultural perspective on impact of health and nutrition claims, country-of-origin and eco-label on consumer choice of new aquaculture products. Food Research International, 123(January), 36–47. https://doi.org/10.1016/j.foodres.2019.04.031

**Bimbo, F., Viscecchia, R., De Devitiis, B., Seccia, A., Roma, R., & De Boni, A.** (2022). How Do Italian Consumers Value Sustainable Certifications on Fish?—An Explorative Analysis. In Sustainability (Vol. 14, Issue 6). https://doi.org/https://doi.org/10.3390/su14063654

**Bougherara, D., Grolleau, G., & Mzoughi, N.** (2007). Is more information always better? An analysis applied to information-based policies for environmental protection. International Journal of Sustainable Development, 10(3), 197–213. https://doi.org/10.1504/IJSD.2007.017643

**Brécard, D., Hlaimi, B., Lucas, S., Perraudeau, Y., & Salladarré, F.** (2009). Determinants of demand for green products: An application to eco-label demand for fish in Europe. Ecological Economics, 69(1), 115–125. https://doi.org/10.1016/j.ecolecon.2009.07.017

**Brécard, D., Lucas, S., Pichot, N., & Salladarré, F.** (2012). Consumer preferences for eco, health and fair trade labels. An application to seafood products in France. Journal of Agricultural and Food Industrial Organization, 10(1). https://doi.org/https://doi.org/10.1515/1542-0485.1360

**Cantillo, J., Martín, J. C., & Román, C.** (2021). Determinants of fishery and aquaculture products consumption at home in the EU28. Food Quality and Preference, 88(May 2020). https://doi.org/10.1016/j.foodqual.2020.104085

**Claret, A., Guerrero, L., Ginés, R., Grau, A., Hernández, M. D., Aguirre, E., Peleteiro, J. B., Fernández-Pato, C., & Rodríguez-Rodríguez, C.** (2014). Consumer beliefs regarding farmed versus wild fish. Appetite, 79, 25–31. https://doi.org/10.1016/j.appet.2014.03.031

**Crevoisier, O., & Jeannerat, H.** (2009). Les dynamiques territoriales de connaissance: Relations multilocales et ancrage régional. Revue d'Economie Industrielle, 128(4), 77–99. https://doi.org/10.4000/rei.4072

**Dufeu, I., Ferrandi, J.-M., Gabriel, P., & Le Gall-Ely, M.** (2014). Socio-environmental multi-labelling and consumer willingness to pay. Recherche et Applications En Marketing, 29(3), 35–56. https://doi.org/https://doi.org/10.1177/2051570714542063

**Feldmann, C., & Hamm, U.** (2015). Consumers' perceptions and preferences for local food: A review. Food Quality and Preference, 40(PA), 152–164. https://doi.org/10.1016/j.foodqual.2014.09.014

**Fonner, R., & Sylvia, G.** (2015). Willingness to Pay for Multiple Seafood Labels in a Niche Market. Marine Resource Economics, 30(1), 51–70. https://doi.org/10.1086/679466

**FranceAgriMer.** (2019). Aquatic products image barometer - Study report - December 2019. https://www.franceagrimer.fr/fam/content/download/63160/document/Synthèse FranceAgrimer - V2 2019.pdf?version=2

**FranceAgriMer.** (2023). Consommation des produits de la pêche et de l'aquaculture 2022. In Données et bilans de l'Etablissement national des produits de l'agriculture et de la mer. https://www.franceagrimer.fr/content/download/72643/document/STA_MER_CONSO_2022.pdf

**Gephart, J. A., Henriksson, P. J. G., Parker, R. W. R., Shepon, A., Gorospe, K. D., Bergman, K., Eshel, G., Golden, C. D., Halpern, B. S., Hornborg, S., Jonell, M., Metian, M., Mifflin, K., Newton, R., Tyedmers, P., Zhang, W., Ziegler, F., & Troell, M.** (2021). Environmental performance of blue foods. Nature, 597(7876), 360–365. https://doi.org/10.1038/s41586-021-03889-2

**Giacomarra, M., Crescimanno, M., Vrontis, D., Miret Pastor, L., & Galati, A.** (2021). The ability of fish ecolabels to promote a change in the sustainability awareness. Marine Policy, 123(November 2020), 104292. https://doi.org/10.1016/j.marpol.2020.104292

**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. https://doi.org/10.1017/S0007114520003773

**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

**Jeannerat, H., & Kebir, L.** (2015). Knowledge, Resources and Markets: What Economic System of Valuation? Regional Studies, 50(2), 274–288. https://doi.org/10.1080/00343404.2014.986718

**Koehn, J. Z., Quinn, E. L., Otten, J. J., Allison, E. H., & Anderson, C. M.** (2020). Making seafood accessible to low-income and nutritionally vulnerable populations on the U.S. West Coast. Journal of Agriculture, Food Systems, and Community Development, 10(1), 171–189. https://doi.org/10.5304/jafscd.2020.101.027

**Koehn, J. Z., Allison, E. H., Golden, C. D., & Hilborn, R.** (2022). The role of seafood in sustainable diets. Environmental Research Letters, 17(3). https://doi.org/10.1088/1748-9326/ac3954

**López-Mas, L., Claret, A., Reinders, M. J., Banovic, M., Krystallis, A., & Guerrero, L.** (2021). Farmed or wild fish? Segmenting European consumers based on their beliefs. Aquaculture, 532(June 2020), 735992. https://doi.org/10.1016/j.aquaculture.2020.735992

**Lucas, S., Soler, L.-G., & Revoredo-Giha, C.** (2021). Trend analysis of sustainability claims: The European fisheries and aquaculture markets case. Food Policy, 104(July), 102141. https://doi.org/https://doi.org/10.1016/j.foodpol.2021.102141

**Martin, H., Martin, R., & Zukauskaite, E.** (2019). The multiple roles of demand in new regional industrial path development: A conceptual analysis. Environment and Planning A: Economy and Space, 51(8), 1741–1757. https://doi.org/10.1177/0308518X19863438

**Salladarré, F., Brécard, D., Lucas, S., & Ollivier, P.** (2016). Are French consumers ready to pay a premium for eco-labeled seafood products? A contingent valuation estimation with heterogeneous anchoring. Agricultural Economics, 47(2), 247–258. https://doi.org/https://doi.org/10.1111/agec.12226

**Salladarré, F., Guillotreau, P., Perraudeau, Y., & Monfort, M. C.** (2010). The demand for seafood eco-labels in France. Journal of Agricultural and Food Industrial Organization, 8(1). https://doi.org/10.2202/1542-0485.1308

**Sirieix, L., Delanchy, M., Remaud, H., Zepeda, L., & Gurviez, P.** (2013). Consumers' perceptions of individual and combined sustainable food labels: A UK pilot investigation. International Journal of Consumer Studies, 37(2), 143–151. https://doi.org/https://doi.org/10.1111/j.1470-6431.2012.01109.x

**Sonntag, W. I., Lemken, D., Spiller, A., & Schulze, M.** (2023). Welcome to the (label) jungle? Analyzing how consumers deal with intra-sustainability label trade-offs on food. Food Quality and Preference, 104(October 2022). https://doi.org/10.1016/j.foodqual.2022.104746

**Thong, N. T., & Solgaard, H. S.** (2017). Consumer's food motives and seafood consumption. Food Quality and Preference, 56(October), 181–188. https://doi.org/10.1016/j.foodqual.2016.10.008

**Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., … Murray, C. J. L.** (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet, 393(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

**Young, W., Hwang, K., McDonald, S., & J Oates, C.** (2010). Sustainable consumption: green consumer behaviour when purchasing products. *Sustainable Development*, *18*(March 2009), 20–31. http://dx.doi.org/10.1002/sd.394

**Zander, K., & Feucht, Y.** (2018). Consumers' Willingness to Pay for Sustainable Seafood Made in Europe. Journal of International Food and Agribusiness Marketing, 30(3), 251–275. https://doi.org/https://doi.org/10.1080/08974438.2017.1413611

COLLEGE SCIENCES DOCTORAL DE LA MER BRETAGNE ET DU LITTORAL

Université de Bretagne Occidentale

## Titre : Transition alimentaire durable et labels : le cas du marché français des produits de la pêche et de l'aquaculture

**Mots clés :** transition alimentaire, produits de la pêche et de l'aquaculture, consommateurs, labels , préférences.

**Résumé :** Cette thèse de doctorat porte sur la consommation des produits de la pêche et de l'aquaculture (PPA). Elle s'intéresse à mieux orienter les consommateurs vers des comportements de consommation plus durables, notamment au travers de l'utilisation des labels. Le marché français est utilisé comme cas d'étude. Cette thèse démontre notamment le caractère non-durable de la consommation française de PPA du point de vue environnemental et santé. Développer l'information et les connaissances des consommateurs envers cette filière est une étape essentielle pour l'adoption de comportements plus vertueux. Si les labels sont un outil pour guider les consommateurs dans leur choix de consommation, cette thèse démontre que les préférences pour ces démarches de labellisation sont aujourd'hui très hétérogènes. Les préférences exprimées sont principalement égoïstes, là où la demande éthique reste-t-elle plus secondaire. Ce travail démontre aussi l'influence du caractère littoral sur les préférences exprimées, et sur les connaissances des consommateurs vis-à-vis du secteur des PPA. Finalement, ce travail démontre qu'associer deux labels sur un même produit (un écolabel et une allégation sûreté) n'est pas forcément valorisé par les consommateurs, et que la méthode de production (pêche vs aquaculture) influence les préférences des consommateurs pour ces labels.

## Title : Sustainable food transition and labelling: the case of the French Fishery and Aquaculture Products market

**Keywords :** dietary transition, Fishery and Aquaculture products, consumers, labels, preferences

**Abstract :** This dissertation focuses on the consumption of fishery and aquaculture products (FAPs). The aim of this work is to better understand how to guide consumers towards more sustainable consumption, in particular through the use of labels. The French market is used as a case study. This thesis demonstrates the unsustainable nature of French consumption of FAPs from an environmental and health point of view. Improving consumers' knowledge of the FAP sector is essential to guide them towards more virtuous behaviour. Although labels are a growing tool to inform and guide consumers in their consumption choices, this thesis shows that their preferences for these labelling approaches are currently very heterogeneous. Consumers' preferences remain egoistic, while ethical demand remains secondary. Our work also shows the influence of coastal areas, on consumers' preferences and knowledge of the FAP sector. Finally, this work is interested in the association between an ecolabel and a safety claim. It shows that the combination of two labels on the same product is not necessarily valued by consumers and that the production method (wild vs. farmed) influences consumers' preferences for these two labels.