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Trend analysis of sustainability claims: The European fisheries and aquaculture markets case

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Abstract:

The future of European fisheries and aquaculture depends not only on their capacity to innovate (e.g., introduce new products) but also on their ability to realize sustainable production given the environmental concerns surrounding fisheries. Market tools can be used to signal sustainability to consumers by balancing sustainability and competitiveness. The purpose of this paper is to explore the trends related to the introduction of fishery and aquaculture products (FAPs) with sustainability attributes among 32,215 products commercialized in Europe between 2000 and 2019 using Mintel's Global New Products Database (GNPD). The data provide information on a variety of sustainability claims on product packages. Of all the FAPs, 35.21% included at least one sustainability claim. We used trend analysis to investigate the countries and species that lead the introduction of new products associated with sustainability to understand the drivers of sustainability in the European FAP markets. The results indicated that the share of FAPs launched in the market with sustainability claims was increasing across Europe, mainly driven by sustainability on raw material and sustainable packaging, while sustainable products with organic or animal welfare claims were not market drivers of sustainability. In addition to differences in the sustainability claims by country, we highlighted some heterogeneity in the market across species. Nevertheless, market incentives to promote

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sustainability, while matching consumer expectations, also seemed efficient in effectively promoting sustainable resources.

Keywords: sustainability claims, ecolabel, trend analysis of time series, fishery and aquaculture market, new product.

Declarations

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Code availability: Stata 14's time-series operators have been used.

JEL Classification: C22, L1, Q11, Q13, Q22

1. Introduction

The consumption of fishery and aquaculture products (FAPs) in Europe has increased substantially in the past few years and reached 24.36 kg per capita in 2018 (EUMOFA, 2020). In 2019, This consumption represents a household expenditure of approximately 56,6 billion euros. Within these countries, the Romania showed the largest increase (8% of household expenditures between 2018 and 2019), while Italy, Spain and France represented larger markets in terms of value (11.686, 10.055 and 8.724 million euros, respectively, in 2019) (EUMOFA, 2020). In terms of household expenditure per capita in 2019, the average in Europe was 110 euros. Portugal remained at first place in the European consumption chart (approximately 371 euros per capita), while eastern countries recorded lower FAP expenditures (15 euros per capita in Hungary and 27 euros in Bulgaria) (EUMOFA, 2020). The increase in FAP consumption was more important for aquaculture products than for captured products. Nevertheless, the European market remained mostly derived from capture fisheries production, which represented 74% of the total apparent consumption in 2018 (EUMOFA, 2020). Furthermore, the self-efficiency of FAPs European market is about 42.5% (EUMOFA, 2020).

It is important to note that the increase in FAP consumption had environmental impacts, such as overfishing or impacts on the ecosystem. In both capture fisheries and aquaculture, the answer to sustainability issues also necessitates matching market expectations and maintaining competitiveness. Nevertheless, investing in more sustainable practices can lead to an increase in production costs, which must be offset by the price to remain competitive in an internationalized market. In addition, the absence of certification can become an entry barrier to trade. In either case, companies need to remain competitive while resolving sustainability issues.

Innovation is an important factor that supports the competitiveness of European companies. It is a driver of FAP consumption and represents an opportunity for companies to match consumers' new expectations and distinguish themselves from competitors (Menrad, 2004; EUMOFA, 2017a; Thong and Solgaard, 2017). Innovation includes product innovations, process innovations, marketing innovations and organizational innovations (OECD, 2005). Furthermore, innovations are not necessarily disruptive changes but can be incremental (OECD, 2005), and they may be firm dependent. A new product or innovation for a firm does not necessarily mean a new product for the market. In the framework of this paper, we focus on innovation that aims to create new products at the firm level. Innovation is either incremental or disruptive and perceptible by the final consumer. Innovation does not always equal a new product but rather is a much broader concept, and we will focus on the latter.

Launching new products on the market is strategic for companies. Both suppliers and retailers need to be competitive, but competitiveness cannot be based only on price and may be based on the ability to answer consumers' needs. Indeed, the competitiveness of the European FAP industry is a major issue for companies, and product differentiation can lead to greater competition. Sustainable positioning is a way to remain competitive, but sustainability is not the only determinant of consumer preferences. Convenience, health, ethics, quality, and price, among other things, drive consumers' preferences for FAPs (Carlucci et al., 2015). Innovation is driven by consumer expectations and company anticipation of future consumption trends (Blezat Consulting et al., 2017). Environmental issues require solutions that can maintain the state of the environment by preventing negative impact while maintaining market competitiveness and answering consumers' needs and expectations. Through the trend analysis of new products, we can extract information regarding retailers and suppliers on their expectations about what

consumers want. The aims of this study are to determine whether the European market succeeds in reconciling both imperative innovation (via new product) and sustainability and whether innovation by firms favor sustainability. Using Mintel's Global New Product Database (GNPD) on new products (Solis, 2016), it is possible to track the launch of new FAPs in the European market. Thus, we can analyze whether the new FAPs in the European market followed a trend toward sustainability.

The structure of the paper is as follows: We present the role played by market tools to signal sustainability to consumers and the trend in Europe in terms of FAPs and sustainable consumption. Then, we present the data used to analyze new FAP trends, the method used, and the results of the trend analysis. Finally, we discuss the results and provide the conclusions.

2. Signaling sustainability to consumers

It is important to note that the aforementioned increase in FAP consumption is not without impacts on the environment, although the impacts may be less consequential than those of meat products (Vieux et al., 2018). If a fish-based diet produces less CO2 than a meat-based diet (Irz et al., 2018; Perignon et al., 2017), the environmental impact of a fish-based diet cannot be estimated by a unique indicator because it depends on the mode of production (for example wild or farmed).

Indeed, fish stocks from capture fisheries need to be well managed to remain sustainable and thus avoid contributing to environmental damage. In 2013, 31.4% of fish stocks were estimated to be overfished (i.e., fished at biologically unsustainable levels), while only 10.5% were underfished (FAO, 2016). Overfishing affects all sea ecosystem equilibria (Gascuel, 2019). The percentage of overfishing has increased in recent years, and the management of resources has not succeeded in

preventing overfishing in spite of the many tools developed. In addition to overfishing issues, two major environmental issues are linked with fisheries: fishery bycatch (of both protected and unprotected species) and marine habitat destruction.

For aquaculture products, despite issues with feeding carnivore species[1], the environmental impacts can be managed through better fish farm management to avoid poor site management, water pollution and local ecosystem disruption. The growth of sustainable aquaculture is part of the challenge of sustainable seafood consumption in the European Union (European Commission, 2012). Indeed, although European aquaculture production is often combined with strict environmental regulation (Guillen et al., 2019), the consumption of aquaculture products mainly rests on importation (EUMOFA, 2020). The evaluation of the environmental impact of seafood-based diets requires multiple indicators (Lucas et al., 2021). Despite the complexity of this evaluation, measures have been taken to make FAPs sustainable. For both capture fisheries and aquaculture, the answer to sustainability issues can be appropriate administrative measures (output and input regulations, geographical zoning and type of fishing gear, etc.) or economic incentives (taxation, right market, etc.) or both (Boude, 2006).

A tool that has emerged to respond to environmental issues is ecolabeling (Charles, 2009) or, to implement larger approaches, sustainability claims. FAP ecolabeling aims to encourage consumers to buy more sustainable products based on the idea that consumers who are informed of the environmental impact of their consumption will be willing to pay more for a more sustainable product. Several studies have highlighted that such a premium occurs for FAPs (see Olesen et al., 2010; Ortega et al., 2014; Roheim et al., 2011; Salladarré et al., 2016; Xu et al.,

[1] Some aquaculture species need feeding from capture fisheries, for which sustainable management of resources applies as well.

2012). Despite the existing debate on the source of interest for these tools, either due to consumer pressure or to the influence of NGOs and branding strategies by retailers (Gutierrez and Thornton, 2014), this price premium will encourage producers to invest in sustainable fishing and farming practices.

In the last few years, the number of sustainability claims on the fisheries sector has increased; thus, this instrument has shown interest. Behind the sustainable management of fisheries resources, the development of sustainability claims supports general environmental concerns. This instrument has been widely used to promote sustainable agricultural practices, more responsible packaging, etc., and it can be observed in the increasing number of organic foods across European stores (organic food consumption increased in value by 9.5% in Europe between 2013 and 2014 (Agence BIO, 2016)). Although the proportion of European aquaculture that is organic is still low on average (3.8% in 2015 (EUMOFA, 2017b)), some EU member states choose to invest in organic production to become more competitive in the farming market. For example, the organic salmon farming industry in Ireland has significantly increased (+ 35% since 2012) production to focus on the organic niche because the producers realized it was difficult to compete with other producer countries in terms of the cost of production, and price of conventional farming. Today, Irish organic farming represents 55.5% of farming production, which produces mainly salmon and mussels (EUMOFA, 2017b).

Ecolabeling and sustainability claims can represent several dimensions of sustainability. Sustainability claims, or ecolabels, can be categorized into three categories (Accenture Development Partners (ADP), 2009). First-party labels are usually established by companies. In this case, a company will use an ecolabel to convey the technical specifications and verify conformity. These label schemes are "self-declarative". Second-party labels are usually

established by industry associations. In this case, the association defines a technical specification for the members, and verification of the member's compliance is generally conducted internally by the association. Third-party labels are usually established by independent entities (public or private). An independent certification body constructs a technical specification, and verification of compliance with standards is separate and conducted by another independent organization. The most credible ecolabeling scheme is third-party labeling in international and voluntary forms (Accenture Development Partners (ADP), 2009). 'Self-declarative' labels are less restrictive and are usually only used as marketing tools to differentiate products. Nonetheless, consumers do not necessarily distinguish between different kinds of labels, although if well informed, they would have a higher trust in independent labeling schemes (Brécard et al., 2012). All approaches are included in the use of the term "sustainability claims", which is why we will use this term to refer to all sustainability attributes signaled to the consumers in the framework of this paper.

Products with sustainability claims can promote several dimensions of sustainability. They can promote fisheries or farming durability. The most developed ecolabels in Europe for those attributes are the Marine Stewardship Council (MSC) and the Aquaculture Stewardship Council (ASC), both of which are third party labels. In 2015, more than 12% of wild seafood worldwide was certified by the MSC, which was created in 1997, and the number of certified fisheries is continuously increasing (MSC, 2019). The ASC certification is a similar program to MSC but with constraints on the environmental management of the farm. FAPs from farmed organisms can also be organic, meaning that they comply with organic standards applied at European level by the EU Organic regulation (European Commission, 2007; 2009). European FAP consumers seem increasingly sensitive to environmental issues, and sustainability will be one of the major consumer expectations in the coming years (Blézat Consulting et al., 2016). Companies use

sustainability claims that best suit their interests to remain competitive in the European market and to promote sustainability that at least matches consumer expectations.

In this paper, we consider all products that claim sustainability to be environmentally friendly products, even if the sustainability attribute does not pertain to FAPs. Sustainability claims can be related to the methods of fishing or farming but can also be used to inform other dimensions related to environmentally friendly packaging or low carbon emissions. For the International Organization of Standardization (ISO), green labels are symbols on packaging to promote the environmental characteristics of products (Zhang et al., 2019). As environmental dimensions are considered credence attributes (Darby and Karni, 1973; Nelson, 1970), the use of claims as a marketing tool can inform consumers by transforming a credence attribute into a research attribute (Roe and Sheldon, 2007). Thus, any product with an environmental claim can be considered an attempt by the supplier to inform consumers that its products possess one or more sustainable dimensions. By looking at all the aspects of sustainability, we will be able to distinguish between initiatives that are based on commitments about the sustainability of the fisheries and farms, and other initiatives that do not rely on changes in FAP production methods (such as packaging).

3. Sustainability of fisheries and consumption in Europe

In Europe, the total household expenditure on FAPs was EUR 56.6 billion in 2019 (EUMOFA, 2020), and fish consumption has increased in the past few years. The average consumption evolved from 13.90 kg/capita/yr in the 1960s to 21.60 kg/capita/yr in 2017 (FAO Stat, 2020). Together with sustainability issues in fisheries, a potential increase in the number of new FAPs with sustainable positioning at the European level has been observed. Indeed, this increase in the number of sustainable FAPs corresponds to an overall increase in sustainability issues with

regard to Western food concerns. The total value of the EU organic food retail market increased from €11.1 billion in 2005 to €24 billion in 2014 (IFOAM, 2016).

Concerning sustainable FAPs, we also observed a positive trend. For sustainable fisheries, the success of the MSC illustrates this point. The number of MSC products sold worldwide reached 28,516 in 2018, while it was only 1,079 ten years earlier (MSC, 2019). European countries added more than half of the new products, showing the attractiveness of this market in Europe. For aquaculture products, several certifications are currently available. The development of integrated multitrophic aquaculture (IMTA) and organic labels is two examples. The EU market for organic products is increasing, with a 73% increase between 2012 and 2016 (EUMOFA, 2017c). Nevertheless, it is still a niche and new market, and it represents on average 1.5% of fish and seafood consumption (EUMOFA, 2017c). Nonetheless, behind this overall unilateral trend toward more sustainable products, European countries do have certain specificities, and different tendencies will likely occur at the country level. Some contextual factors can influence this evolution. Thøgersen (Thøgersen, 2010) highlighted the importance of macro determinants, such as political determinants (regulation and market development) and market determinants (demand and supply side over individual preferences and choices) to explain more sustainable consumption across countries.

The level of FAP consumption is not uniform across European countries. Some countries are traditionally important consumers, such as Norway (40.40 kg/capita/yr in the 1960s and 52.08 kg/capita/yr in 2013) or Portugal (55.60 kg/capita/yr in the 1960s and 60.92 kg/capita/yr in 2018). In some countries, FAPs are rarely consumed, as in Hungary or Romania (approximately 2 kg/capita/yr in the 1960s, and 6.12 kg/capita/yr and 7.99 kg/capita/yr in 2018, respectively) (EUMOFA, 2020; FAO, 2016; FAOSTAT, 2020). Between 2018 and 2019, all European

countries had increased household expenditures on FAPs (EUMOFA, 2020). The major markets in Europe remained Italy, Spain, France, Germany, the UK, and Portugal in terms of household expenditure on fish and seafood in 2019 (EUMOFA 2020).

If we look at the per capita household expenditure for FAPs, Portugal registered the highest value, at approximately three times the EU average. The lower per capita household expenditures were mainly in eastern countries (Hungary, Bulgaria, Poland, Czech Republic, Slovenia, and Croatia). Per capita expenditures or per capita consumption, including household expenditures, were highest in Italy, Spain, and Portugal always but lowest in Hungary and Slovenia. This finding highlights the non-homogeneity of FAP consumption in Europe, with a larger gap between southern European countries and Eastern European countries.

The value of FAP consumption is related to the species consumed because species have different values. In eastern and central European countries, member states mainly consume freshwater-farmed fish (e.g., salmon, carp, and pangasius) or wild marine fish with low average values (e.g., mackerel, cod, hake) (EUMOFA, 2017a). In contrast, most of the member states with higher FAP consumption consume marine fish, which are often wild species with higher average values (seabream, shrimp, squid octopus) (EUMOFA, 2017a).

Furthermore, the individual implication through demand behavior on environmental issues is a key factor. A European survey in 2014 showed that a more consequential percentage of consumers from northern countries had bought environmentally friendly products marked with environmental labels for environmental reasons in the past month (60% of Sweden versus 9% of Portuguese (Eurobarometer, 2014)). We can expect that greater acceptance of environmentally friendly products will favor the development of sustainable products on the FAP market.

However, the division of the groups of countries by sustainable consumption was not similar to that by FAP consumption. A more important market share of organic food retail sales is currently observed in Denmark, Switzerland, Austria, and Sweden (7.6, 7.1, 6.5, and 6%, respectively) (IFOAM, 2016). Furthermore, Germany is often considered a mature market for organic products (Meyer-Höfer, Nitzko and Spiller, 2015; Meyer-Höfer et al., 2015). A lower share of organic retail sales (0.2%) has been observed in five countries (Slovakia, Portugal, Poland, Lithuania, and Latvia). The northern market for environmentally friendly products is more mature than the southern and Eastern European markets, and consumers from those markets are more used to buying sustainable products, such as organic products (Torjusen et al., 2004).

Sustainable new products could involve more environmentally friendly packaging choices or sustainability of the production process of the species itself. Those choices involve different degrees of implication, and the claims are not similarly perceived. European consumers ambivalently perceived the positioning of organic certification in regard to wild and farmed fish or other attributes (Altintzoglou et al., 2015; Carlucci et al., 2015), and nonorganic environmental labels benefitted from better recognition (EUMOFA, 2017b). In some central Eastern European countries, organic certification is considered irrelevant because traditional and very extensive farming, such as that of carp, is viewed as an ecological product (EUMOFA, 2017b).

Carp is among the most widely spread farmed fish in Europe, mainly in Eastern Europe countries (EUMOFA, 2017b). Thus, this perception of organic certification is linked to the fact that those countries are major producers of freshwater species. Indeed, Torjusen, Sangstad, O'Doherty and Kjærnes (Torjusen et al., 2004) suggested that the structure of agricultural production has an impact on the environmental friendliness of the market. In addition, some studies on ecolabel seafood consumption have highlighted the role played by the distance of the consumer to the

seaside (Brécard et al., 2009). Thus, the importance of fisheries and aquaculture in the economy of a country may have an impact on the development of sustainable FAPs. In Europe, the share of employment in the FAP sector (fisheries, aquaculture and processing) is relatively low (between 6.29% of the active population in Greece and almost zero in Hungary[2]). Finally, distribution channels also impact the sustainable market, influencing product availability.

Thus, European consumption of FAPs and the context that may influence the development of sustainable FAPs are not homogeneous across countries. Some countries have low FAP consumption and a weak market for sustainable food certification, with a low percentage of people buying environmentally friendly products marked with an environmental label for environmental reasons (hereafter, sustainable consumption acceptance); the FAP sector may not be important for the country's economy. This is the case for central Eastern European countries. Some countries have low FAP consumption and low employment in this sector but have an important sustainable food market and a high percentage of sustainable consumption acceptance. This is the case for Germany, Austria, the Netherlands, and Denmark. Some countries have high FAP consumption and an important level of employment in the sector, while the sustainable food market is small and sustainable consumption acceptance is low. This is the case for southern European countries, such as Portugal, Spain, Italia and Greece[3]. Other countries also have specific patterns, thus leading to a heterogeneous market.

[2] Authors' elaboration based on EUMOFA (EUMOFA, 2017d) for fisheries employment data and the World Bank for population employment data

[3] Spain, Italia and Greece represent 65% of the employment in the European fishing sector (https://ec.europa.eu/fisheries/3-employment_en).

4. Data and methods

4.1. Database

To analyze the evolution of sustainable new products in the European market, we looked at the evolution of sustainable products between 2000 and 2019 across European countries covered by the GNPD[4]. The main objective of the GNPD is to provide data on the depth of resources necessary to track trends in product innovation and retail success. Product innovation is tracked in shops and online across 62 of the world's major economies, and approximately 33,000 new products per month are added to the database. Eighty fields of information ranging from company information and flavor to packaging and positioning are noted. This database allows access to the product characteristics, marketing positioning and type of launches, but it is only focused on packed products. It provides detailed data on new products launched in the food, beverage, beauty and personal care, healthcare, household goods and pet care markets (for more information on GNPD, see Solis, 2016).

The innovations are from five different launch types: new products, new packaging, new recipes, extensions of the range and product relaunches. New products correspond to new lines or new families of products for brands; thus, this kind of launch is brand dependent. New products also include branded products that are launched in a new country where the product was not previously commercialized (Mintel International Group Ltd., 2012). New packaging is based on the visual aspect of the product and corresponds to a product labeled "new look", "new size" or "new packaging" (Mintel International Group Ltd., 2012). New recipes concern new ingredient formulations in existing products. An extension of the range depends on the brand line; it is assigned when a new product is a horizontal extension of an existing line (Mintel International

[4] Mintel, a market intelligence agency, working across 34 countries worldwide, constructs GNPD.

Group Ltd., 2012). Finally, new products are defined as relaunches when indicated on the product packaging or when a secondary information source informs consumers (trade show, website or press). It is also assigned when the product has been both reformulated and given new packaging (Mintel International Group Ltd., 2012). Thus, product and marketing innovations are primarily noted in this database because major process or social innovations are not visible to the shopper.

For this analysis on the European FAP market, we looked at food products containing seafood as major ingredients. To be selected for this analysis, seafood had to be one of the five main ingredients. The European market as delimited (and covered) by Mintel concerns 32 countries: Austria, Belgium, Belarus, Bulgaria, Croatia, Denmark, Spain, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italia, Latvia, Lithuania, Norway, the Netherlands, Poland, Portugal, the Czech Republic, Romania, the United Kingdom, Russia, Serbia, Slovakia, Slovenia, Sweden, Swiss, Turkey and Ukraine. Between 2000 and 2019, 34,215 FAPs were launched on the European market (based on Mintel's GNPD, 2020).

As previously mentioned, different product positioning can match consumer expectations. These positioning claims can be related to sustainability claims (e.g., organic, environmentally friendly products, ecolabeling, animal welfare), convenience claims (e.g., ease of use, microwaveable), natural claims (e.g., no additives/preservatives, GMO free), health claims (e.g., antioxidant, vitamin/mineral fortified) or other claims (e.g., fair trade, kosher, premium) (see Table A.1 for details). Between 2000 and 2019, 67.41% of new FAPs had at least one claim, and the number of products without any claim continuously decreased over the period considered. Products without claims represented 68.30% of the products launched in 2000, while they represented only 22.12% in 2019. The most commonly used claims were that the product was sustainable or convenient (35.21 and 27.92% of FAPs over the period, respectively). These claims are also the major trends

in the seafood sector internationally (Mintel International Group Ltd, 2019) and correspond to the main consumer concerns regarding fish consumption (Roheim, 2009; Steinar Valle et al., 2016; Thong and Solgaard, 2017).

For sustainability claims (hereafter SC), fisheries stock management and the environmental impact of aquaculture have increasingly been considered in the public debate. The success of petitions for fisheries management, which go behind the individual involved in the sector, is an example of this popular awareness (for example, a petition against deep-sea fish fisheries launched by the BLOOM association obtained more than one million signatures (Bourneuf, 2016)). In regards of aquaculture, the large diffusion on television of documentaries about scandal in Salmon aquaculture farms (Girard, 2013; Lorenzo, 2016) increase the popular awareness of the environmental impact of aquaculture whilst affecting salmon consumption in France (EUMOFA, 2016a). Concern for the sustainability impact of food consumption is a common trend for all food products (Blezat Consulting et al., 2016a).

For convenience claims, this attribute of FAPs is an important restraint on fish consumption. Some consumers do not have the knowledge to prepare unprocessed fish, and fish is not perceived as an easy product to buy, preserve and cook (Brunsø et al., 2008; Olsen, 2003). Furthermore, convenience positioning is a more general food tendency leading to lower cooking time and more easy-to-eat/easy-to-cook products (Brunner et al., 2010; Blezat Consultinget al., 2016b).

The types of positioning we considered were those indicating sustainability. As mentioned above, this issue is important for seafood industries because some stocks are overexploited (FAO, 2016), and one way to improve the situation is to use demand incentives. Sustainability is viewed overall

and does not restrain FAP attributes. Indeed, all attributes that increase sustainability can be claimed. Five categories matched this definition in the database: carbon neutral, organic, environmentally friendly (EF) packaging, EF product (hereafter EF raw material to avoid confusion with the overall category "sustainable products") and animal welfare. The proportion of FAPs in each category was variable. Carbon neutrality was rarely used in the sector, as only 0.05% of the products in the database used these claims, while 24.64% of products used EF raw material claims (Table 1)[5]. Among the EF claims were third-party labels, such as MSC, and first- and second-party labels, such as "responsible fishing" (Accenture Development Partners (ADP), 2009). The repartition of the claims was also variable across species, with animal welfare widely used for tuna (the "Dolphin Safe" logo is a long-standing and important label in the tuna industry (Boreman, 1992, Teisl et al., 2002) but not used at all for many other species (see Table A.2 for details). The most numerous claims were environmentally friendly packaging and raw material, which represented 38.08 and 69.98% of sustainable products, respectively. Of course, one product can have multiple claims (on average, sustainable FAPs have 1.40 SC).

Table 1 Sustainable claims details by types of claims: carbon neutral, organic, environmentally friendly (EF) packaging, EF raw materials and animal welfare.

Number of products		Percentage of sustainable products with at least one claim				
		Carbon neutral	Organic	EF packaging	EF raw material	Animal welfare
Sustainable	**12,046**	**0.14**	**9.86**	**38.08**	**69.98**	**21.91**
All	**34,215**	**0.05**	**3.47**	**13.41**	**24.64**	**7.71**

Note: Number of observations: 34,215 products and 12,046 products with at least one environmental claim. As products may have more than one claim, the percentage does not add to 100%. Source: Authors' elaboration based on the GNPD database (2000-2019).

The number of products with SC increased across the period. Only 1.34% of the FAPs included in the GNPD in 2000 had sustainable positioning, while these products represented 55.73% of FAPs in 2019. This evolution is not identical across all European countries. In 2000, only two countries had new products with SC: Germany and the United Kingdom (4% and 3.51% of new

[5] Hereafter, carbon neutral claims will be included in EF raw material.

FAPs, respectively). Twenty years later, all countries had new products with SC on their market, but the gap between countries remained. Some countries had launches of almost exclusively sustainable innovations (100% of launched products in 2019 in Ireland had SCs), while only 2% of the new products in Ukraine had this positioning. The most important firms involved in the launch of sustainable products were mostly major firms in the FAP sector (see Table A.3) and were both retailers and manufacturers. In total, 4,597 firms launched at least one FAP on the European market, and 1,448 had at least one product with SC. Lidl and Marks & Spencer (M&S) were the most innovative companies regarding sustainability. Almost 11% of the new products with SC in Europe between 2000 and 2019 were launched by Lidl and M&S, while those brands represented only 8% of new FAPs in the same period.

The database documents the ingredients in each product, which provides information on the species used. Unfortunately, European legislation regarding species appellation on packaged products is not complied with, and it is very rare for the *Latin name* to be listed (which would have been the only way to be certain about the species). The origin of fish as well as the production method (wild or farmed) is not mandatory either. Furthermore, the name of the species is not even required, as 4.44% of new FAPs have no specified species as major ingredients. Under this condition, it is impossible to classify species very precisely. Nevertheless, this finding revealed what information is available for the consumer. Thus, we classified fish into general categories allowing us to analyze new products related to the main categories of species (see Table A.4 for further details in category construction). Those general categories will be later referred as "species" in the paper. Due to the low number of new freshwater species products in the database, we did not distinguish between farmed and wild fish, although most of the freshwater species came from aquaculture (EUMOFA, 2017b).

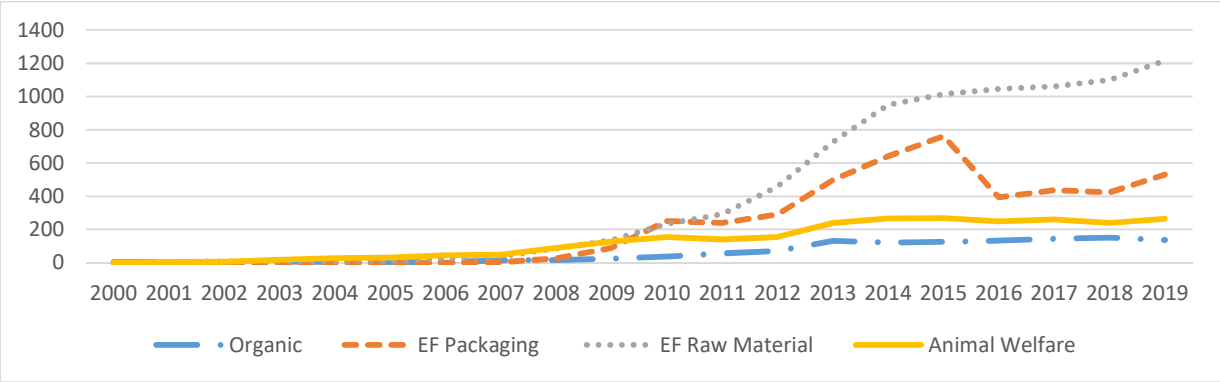

Figure 1 Number of sustainable FAPs by claims. Nb of Observations: 12,046 products with at least one environmental claim Source: Authors' elaboration based on the GNPD (2000-2019).

The use of SC is not equal across species. The major species on the European market are salmon, tuna, and shrimp (21.86, 14.67, and 14.63% of FAPs, respectively), and they are the main species among sustainable products. The species with the highest share of SC were pangasius and pollock (61.32 and 56.33%, respectively). The species with the lowest proportion of products with SC was cephalopods, with only 12.03% of cephalopod products listing SC (see Table 2 for details on the main species). Overall, the descriptive statistics showed that the market for sustainable products was increasing across Europe (see Figure 1) but that this increase was not homogenous across species and countries.

Table 2 Distribution of sustainable new products by species

Species	Number of products in the database	Percentage of European FAP market (%)	Number of products with at least one SC	Percentage of products with at least one SC (%)	Percentage of products with at least one sustainability claim with respect to the total FAP market (%)
Fish wild	**15,595**	**45.58**	**6,508**	**41.73**	**19.02**
Main species					
Tuna	5,017	14.66	2,484	49.51	7.26
Cod	2,436	7.12	1,017	41.75	2.97
Pollock	1,677	4.90	963	57.42	2.81
Herring	1,374	4.02	513	37.34	1.50
Fish farmed	**8,546**	**24.98**	**3,012**	**35.24**	**8.80**
Main species					
Salmon	7,478	21.86	2,708	36.21	7.91
Trout	865	2.53	230	26.59	0.67
CCS* - wild	**8,294**	**24.24**	**2,150**	**26.26**	**6.28**
Main species					
Crustaceans	5,926	17.32	1,747	29.48	4.52
CCS* - Farmed	**5,880**	**17.19**	**1,790**	**30.44**	**5.23**
Main species					
Shrimp	5,007	14.63	1,548	30.92	4.44
Freshwater fish**	**744**	**2.17**	**266**	**35.75**	**0.78**
Main species					
Pangasius	250	0.73	153	61.20	0.45
Unspecified	**1,519**	**4.44**	**204**	**13.43**	**0.60**

**Crustaceans, cephalopods and shellfish **Without salmonid*

Note: Number of observations: 34,215 products and 12,046 products with at least one environmental claim. The sum of products and products with sustainability claims by species was 39,059 and 13,928, respectively (without unspecified) because products can be composed of multiple species. The average number of species by product was 1.10 for general products and 1.05 for products with at least one environmental claim (without unspecified). Key finding: A total of 15,595 new products containing wild sea fish have been launched in Europe, representing 45.58% of new products containing seafood. Among them, 6,508 products had sustainability claims (41.73% of wild sea-fish products). In addition, 19.02% of FAPs contained wild marine fish and had sustainability claims. Source: Authors' elaboration based on the GNPD (2000-2019).

4.2. Methodology

To examine the trend of sustainable FAPs in the European market, we performed two analyses. First, we looked at the trend of FAPs with SC in each European country. Second, we looked at the evolution of the number of FAPs with SC by product category (e.g., species, brand) at the European level, as well as by the groups of countries constructed from the previous analysis.

For all countries, the number of products with or without SC increased over the period. Nonetheless, this tendency could be due either to an increase in new FAPs or to the extension of the coverage of the EU market by Mintel. To avoid any bias, we looked at the evolution of the importance of sustainable products. Therefore, we applied a trend analysis (OLS linear regression) of the share of products with SC (x) with respect to the total number of products

launched (*n*) in the country (subscript *i*). We used the sum of the number of products for each category per year and per area. This ratio is represented by y_i. The time interval corresponds to a year[6], caught by t. The estimation equation is (1), where α_s represents the parameters to estimate:

$$\frac{x_i}{n_i} = y_i = \alpha_0 + \alpha_1 \cdot t \qquad (1)$$

To control for the strength of the launching of sustainable products by country, location quotients were constructed by country (Wheeler, 2005; Costa-Font and Revoredo-Giha, 2016). A location quotient is a way of measuring the relative contribution of one specific category to the whole for a given outcome. In our case, we looked at the relationship between y_i, which is the share of sustainable products in each country, and y, which is the share of sustainable products at the European level. Thus, the location quotients for country *i* were as follows:

$$LQ_i = \frac{\frac{x_i}{n_i}}{\frac{x}{n}} = \frac{y_i}{y}, \qquad y > 0 \qquad (2)$$

We also submitted this location quotient to a trend analysis. The result of the trend analysis on LQ (2) will allow us to emphasize the driver of the SC FAP market. This trend analysis on LQ (2) comes in addition to what the overall tendency grasps by the trend of share of sustainable product measure by (1).

In the second part of the analysis, we used the same tools to analyze the tendency of sustainable FAPs, although in this case, y_i represented the share of products with sustainability claims with

[6] Although information at the month level is available, we performed an analysis at the year level. Indeed, in the database, the month matched the time of purchase and not necessarily the time of launch; thus, yearly evaluations minimized this bias.

respect to the total number of products launched by category (species, type of SC). Additionally, the LQ was applied to the same categories. A trend analysis was performed on both estimators.

5. Results and discussion

5.1. Diversity of claims related to sustainability across European countries

The evolution of sustainable products across Europe was positive and significant, meaning that the launch of FAPs with SC increased faster than the overall launch of FAPs (Table 3). This assessment was true for every European country[7]. The fastest growth was in Ireland, the Netherlands and the United Kingdom, where the slope was the highest. The eight countries with the fastest growth in the share of sustainable products (Ireland – 6.025, Netherland – 5.137, the United Kingdom – 4.979, Sweden – 4.537, Germany – 4.272, Austria – 4.251, Switzerland – 3.799, France – 3.758) were also countries where a consequential part of the population bought environmentally friendly products marked with an environmental label (see Table A.5). This finding highlights the fact that sustainable FAPs were in line with a global change in food choices. These countries were also mainly northern countries. However, eastern countries as well as the majority of Mediterranean countries had low slopes, meaning that there was a slower increase in the share of sustainable FAPs among the overall FAPs (with the slowest slope for Russia – 0.541).

[7] For every country with enough observations.

Table 3 Results of the trend regression on the share and location quotient (LQ) of FAPs with sustainability claims by country

Country	**Share** Trend *(s.e.)*	**LQ** Trend *(s.e.)*	Observations (years)
Europe	3.046*** *(0.161)*		20
Ireland	6.025*** *(0.483)*	0.084** *(0.035)*	19
Netherland	5.137*** *(0.428)*	0.089*** *(0.026)*	20
United Kingdom	4.979*** *(0.330)*	-0.060*** *(0.012)*	20
Sweden	4.537*** *(0.515)*	0.085*** *(0.020)*	20
Germany	4.272*** *(0.302)*	NS	20
Austria	4.251*** *(0.303)*	0.061*** *(0.016)*	19
Switzerland	3.799*** *(0.921)*	NS	19
France	3.758*** *(0.264)*	0.078*** *(0.006)*	20
Finland	3.704*** *(0.542)*	0.079*** *(0.015)*	20
Belgium	3.367*** *(0.414)*	NS	20
Denmark	3.570*** *(0.373)*	0.076*** *(0.108)*	20
Czech Republic	3.565*** *(0.437)*	0.047** *(0.022)*	18
Portugal	3.483*** *(0.540)*	NS	18
Turkey	3.217*** *(0.713)*	NS	18
Greece	3.022*** *(0.311)*	0.055*** *(0.012)*	19
Hungary	2.293*** *(0.445)*	0.043** *(0.016)*	18
Norway	2.421*** *(0.407)*	0.051*** *(0.014)*	20
Italy	2.015*** *(0.169)*	0.025** *(0.009)*	20
Spain	1.694*** *(0.213)*	NS	20
Poland	1.285*** *(0.426)*	NS	20
Russia	0.541*** *(0.114)*	0.011*** *(0.003)*	16

Source: Authors' elaboration based on Mintel's GNPD data (2000-2019).

Note: Sig: *** 1%, ** 5%. NS means that the estimation is either nonsignificant or that the p-value of the joint F test for the coefficient is above 5%. Insufficient observations were available for Belarus, Bulgaria, Estonia, Latvia, Lithuania, Serbia, and Slovenia. Standard errors are in parentheses. For all displayed results, the p-value of the joint F test for the coefficient is less than 5%. Constants are not displayed for legibility reasons, but all models included such values because for a majority of estimations AIC/BIC were optimized with the constant. The results for Ukraine, Slovakia, Croatia and Romania are all NS.

If we look at the LQ quotient, these results can be affirmed. The LQ aimed to compare the share of products with SC in each country with that observed at the European level. We found that the three main countries where the share of sustainable FAPs was increasing significantly faster than the average rate at the European level were the Netherlands, Sweden and Ireland (0.089, 0.085, 0.084, respectively). However, the difference in LQ coefficient with following countries (Austria, France, Finland and Denmark) is not large enough to reject layering and they are not significantly

different from each other and all the other countries[8]. Still these countries can be considered as drivers of the European market toward sustainability. Only one country had an increase that was significantly slightly lower than the European trend: the UK (-0.06). Indeed, we observed a higher share of sustainable FAPs in the UK than in Europe. However, in terms of growth rate, both markets were close, and the share of SC FAPs in the UK market was growing at a regular rate that was comparable to the growth rate of the European market. Thus, the UK market for sustainable FAPs grew quickly, but its relative contribution to the European market decreased slightly. Overall, markets that were less regular, such as Sweden, contributed more obviously to European dynamics (see Graphic A.1).

Positive development towards a sustainable FAP market has been observed in Europe. Faster development is observed in northern countries overall because the more important increases were in northern European countries while the slower market development was mainly in southern and eastern European countries, although some exceptions. Thus, among significant results, northern European countries seem to display sustainability on commercialized products because a majority of them show significantly higher that LQ than southern countries[9]. Nevertheless, as underlined by the trend analysis on share, all European markets for SC FAPs are expanding (among countries with enough observations).

5.2. Detailed analysis of sustainability claims by European country group

[8]Wald tests have been performed to test equality of coefficient between countries (significance threshold at 5%)

[9]Wald tests have been performed to test equality of coefficient between countries and the coefficients from northern European countries (Netherland, Sweden, Denmark, UK) are significantly different from coefficients from southern countries (Italy and Greece, significance threshold at 5%). If Ireland and Finland are significantly different from Italy (significance threshold at 10% and 5% respectively), that not the case from Greece. Similarly, Norway is significantly different from Italy (significance threshold at 5%), but not from Greece, although it is significantly different from northern countries (significance threshold at 5%).

The evolution of the share of sustainable products was not identical depending on the specific claim, and we distinguished some differences across groups of countries. To avoid missing observations due to the large number of studied countries, for the following analysis, we looked at the trend by groups of countries that shared similar trends in SC for new FAPs and consumption patterns. The country groups were constructed based on consumer behavior (average FAP consumption and environmental conscientiousness, Table A.5) and geographical proximity and then confirmed by the previous analysis (analysis in 5.1). If data were not available, then we matched countries based on geographic proximity because proximity facilitates exchange and thus favors common market dynamics (Head and Mayer, 2014; Yang et al., 2020) (see Table 4 for the country repartition).

Table 4 Distribution of countries by group

Group	Countries	Years of Observations
Germanic	Germany, Netherland, Switzerland and Austria: *6,981 products (including 3,419 sustainable),*	20
Franco-Belge	France and Belgium: *6,374 products (including 2,387 sustainable)*	20
Iberian	Portugal and Spain: *4,273 products (including 831 sustainable)*	20
Anglo-Saxon	UK and Ireland: *4,736 products (including 2,769 sustainable)*	20
Mediterranean	Italy, Croatia and Greece: *4,223 products (including 962 sustainable)*	20
Scandi	Denmark, Norway, Sweden and Finland: *2,738 products (including 909 sustainable)*	20
East	Belarus, Bulgaria, Estonia, Latvia, Lithuania, Serbia, Slovenia, Czech Republic, Poland, Slovakia, Ukraine, Romania, Russia, Turkey and Hungary: *4,890 products (including 769 sustainable)*	20

Source: Authors' elaboration based on the GNPD database (2000-2019). Europe: 34,215 products (including 12,046 sustainable); observations over 20 years are available for the entire country group.

At the European level, we observed an increasing number of new products with all kinds of sustainability claims (see Figure 1). This increase was observed for every country group. However, behind those new products, we highlighted the differences between the overall strategies (see Table 5). If we observe an increase for each claim in every country group, then the most important increase at the European level is for EF raw material. This finding shows the

increased demand for sustainable products that take into account the specificities of the FAP products as stock management. This increase in products with EF raw material claims is particularly strong for the Germanic country group. The increase in organic claims is smaller than the increase of others SC in the Germanic market. However, the Germanic market had the larger increase in organic claims at the European level. A larger increase in sustainable packaging claims is observed for the Franco-Belge market, while animal welfare is observed for Mediterranean markets. In general, all claims are increasingly used at the expense of unclaimed products.

Table 5 Regressions of the number of FAPs by sustainability claims on time (year) for each European country group over 20 years

		Germanic	Franco-Belge	Iberian	Anglo-Saxon	Mediterranean	Scandi	East	Europe
Organic	Trend	3.437***	3.222***	0.643***	0.314***	0.718***	0.571***	0.513***	9.419***
	(s.e.)	*(0.391)*	*(0.329)*	*(0.129)*	*(0.074)*	*(0.106)*	*(0.111)*	*(0.081)*	*(0.848)*
Sustainable packaging	Trend	4.798***	12.240***	2.165***	12.231***	1.873***	2.052***	1.328***	36.689***
	(s.e.)	*(0.543)*	*(2.382)*	*(0.507)*	*(1.858)*	*(0.208)*	*(0.459)*	*(0.179)*	*(5.103)*
EF raw material	Trend	26.815***	9.457***	3.032***	14.105***	7.326***	7.292***	5.843***	73.855***
	(s.e.)	*(2.664)*	*(1.200)*	*(0.321)*	*(1.352)*	*(0.842)*	*(1.077)*	*(0.716)*	*(6.886)*
Animal welfare	Trend	2.780***	2.586***	1.948***	3.113***	3.724***	0.867***	2.050***	17.070***
	(s.e.)	*(0.515)*	*(0.325)*	*(0.477)*	*(0.483)*	*(0.457)*	*(0.205)*	*(0.205)*	*(1.127)*

Source: Authors' elaboration based on Mintel's GNPD data (2000-2019).

Note: Sig: *** 1%. Standard errors are in parentheses. The p-value of the joint F test for all the coefficients is less than 0.1% for all estimations. Constants are not displayed for readability reasons, but all models included such values because for a majority of estimations, AIC/BIC was optimized with a constant.

Among the shares of each claim over sustainable products as a whole, the share of EF raw material and sustainable packaging claims increases significantly (0.026 and 0.027, respectively) at the European level (see Table 6). Conversely, the share of organic and animal welfare claims significantly decreased (-0.019 and -0.028, respectively, see Table 6).

Table 6 Regressions of the share of each sustainability claim over sustainable FAPs on time (year) for each European country group over 20 years

		Germanic	Franco-Belge	Iberian	Anglo-Saxon	Mediterranean	Scandi	East	Europe
Organic	Trend	-0.032***	NS	NS	-0.018**	0.006***	NS	NS	-0.019**
	(s.e.)	*(0.009)*			*(0.008)*	*(0.001)*			*(0.007)*
Sustainable packaging	Trend	0.011***	0.043**	0.027***	0.045***	NS	0.018***	0.014***	0.027***
	(s.e.)	*(0.002)*	*(0.006)*	*(0.005)*	*(0.007)*		*(0.006)*	*(0.004)*	*(0.005)*
EF raw material	Trend	0.035***	NS	NS	0.030***	0.029**	0.046***	0.040***	0.026***
	(s.e.)	*(0.010)*			*(0.008)*	*(0.012)*	*(0.012)*	*(0.011)*	*(0.006)*
Animal welfare	Trend	NS	NS	NS	-0.032**	NS	NS	NS	-0.028***
	(s.e.)				*(0.011)*				*(0.009)*

Source: Authors' elaboration based on Mintel's GNPD data (2000-2019).

Note: Sig: *** 1%, ** 5%. Standard errors are in parentheses. The p-value of the joint F test for all the coefficients is less than 5% for all displayed estimations. NS means that either the results were not significant or that the Prob>F was higher than 5%. Constants are not displayed for readability reasons, although all models included such values because for a majority of estimations, AIC/BIC was optimized with a constant.

EF raw material claims appear to be a central component in fisheries management at the European level because the use of this claim increases faster than the number of sustainable products as a whole. This assessment does not stand for the Franco-Belge and Iberian markets.

Regarding sustainable packaging claims, the evolution across the studied period has the same dynamic as that for EF raw material claims at the European level. At the country group level, differences are found for the Mediterranean market: sustainable packaging does not have a significant growth whereas raw material increase faster than the number of sustainable products as a whole. Inverse results are found for the Franco-Belge and Iberian market.

The share of organic and animal welfare claims over SC FAPs significantly decreased at the European level over the period. At the country groups' level, it decreases for Anglo-Saxon, but the regressions for most country groups were not significantly different from zero. Both claims were less numerous in the studied period (only 3.47 and 7.71% of the products claimed organic labeling and animal welfare, respectively; see Table 1) and heterogeneously implemented across the FAPs sector.

For organic claims, two situations were highlighted. Either the fish itself was claimed to be organic, in which case it could only be farmed, or another component of the product was claimed

to be organic (oil in mackerel cans, for example). In the first scenario, the market data show that 1% of FAPs originated from organic production (EUMOFA 2016b). The most important species labeled organic was salmon (41.16% of organic products in the database contained salmon), which was also one of the most consumed species across Europe. Nonetheless, organic FAPs remained a niche (EUMOFA 2016b), and despite an increase in demand and in the sales volume, it did not make the main share of sustainability claims of new FAPs in Europe.

In addition to tuna products, products focusing on animal welfare represent a niche market, despite an increase in concern in society for animal welfare issues and its extension from farm animals to fish (Ellingsen et al., 2015; Veldhuizen et al., 2018; Le Breton, 2019). Seventy-four percent of sustainable tuna products claimed animal welfare, while it was only 3% for mussels (less subject to animal welfare concerns or very recently (Diggles, 2018)) and 5.13% for nonspecified species. Most animal welfare claims were related to bycatch issues. Thus, the complexity of apprehending bycatch issues (with strong variation across fisheries, gear technology, time and area fished (Bensley et al., 2010) at least partially explains why the use of this claim did not increase to drive sustainability across Europe.

5.3. Detailed analysis by fish category for each European country group and for each SC

If SC products are country dependent, then they are also species dependent. The share of SC products significantly increased at the European level for all the species (Table 7), but only the share of SC for freshwater fish and unspecified species increased at a higher rate than the share of SC across new FAPs (0.061 and 0.039, respectively, Table 8). This result means that the increase in sustainability for the wild cephalopods, crustaceans, and shellfish (CCS), the farmed CCS, the wild fish, and the farmed fish are in reality growing at the same rate as the number of SC FAPs

and that sustainability drives only the market for freshwater fish and unspecified. The share of SC freshwater fish increased faster than the share of SC FAPs, and this trend stands for all European groups of countries, except for the East market (Table 8).

Table 7 Results of regressions on share of SC FAPs within fish categories on time (year) for each European country group over 20 years

		Germanic	Franco-Belge	Iberian	Anglo-Saxon	Mediterranean	Scandi	East	Europe
Wild CCS[1]	Trend	3.601***	2.610***	0.929***	4.306***	0.729***	3.915***	0.599***	2.279***
	(s.e.)	*(0.315)*	*(0.197)*	*(0.186)*	*(0.347)*	*(0.129)*	*(0.604)*	*(0.151)*	*(0.107)*
Farmed CCS[1]	Trend	3.944***	3.033***	1.305***	4.707***	0.637***	4.626***	0.876***	2.713***
	(s.e.)	*(0.336)*	*(0.262)*	*(0.217)*	*(0.360)*	*(0.129)*	*(0.661)*	*(0.147)*	*(0.156)*
Wild fish	Trend	5.545***	4.174***	2.522***	5.332***	2.900***	4.431***	1.483***	3.665***
	(s.e.)	*(0.381)*	*(0.303)*	*(0.224)*	*(0.412)*	*(0.231)*	*(0.287)*	*(0.311)*	*(0.198)*
Farmed fish	Trend	3.606***	4.040***	1.363***	5.208***	1.753***	1.755***	0.954***	2.808***
	(s.e.)	*(0.295)*	*(0.295)*	*(0.417)*	*(0.430)*	*(0.223)*	*(0.247)*	*(0.159)*	*(0.224)*
Freshwater fish[2]	Trend	4.356***	2.513***	2.882***	4.950***	2.501***	4.170***	0.462**	3.090***
	(s.e.)	*(0.550)*	*(0.565)*	*(0.796)*	*(1.020)*	*(0.395)*	*(1.123)*	*(0.218)*	*(0.332)*
Unspecified	Trend	4.939***	2.593***	1.250***	2.206**	1.550**	2.266***	0.225**	2.052***
	(s.e.)	*(0.782)*	*(0.285)*	*(0.304)*	*(1.011)*	*(0.623)*	*(0.640)*	*(0.097)*	*(0.202)*

Source: Authors' elaboration based on Mintel's GNPD data (2000-2019)

Note: Sig: *** 1%, ** 5%. Standard errors are in parentheses. The p-value of the joint F test for all the coefficients is less than 5% for all displayed estimations. NS means that either the results were not significant or that the p-value of the joint F test for all the coefficients was above 5%. Constants are not displayed for readability reasons, although all models included such values because for a majority of estimations, AIC/BIC was optimized with a constant.

[1] Cephalopods, crustaceans, and shellfish.

[2] Due to the low number of new freshwater species products in the database, we did not distinguish between farmed and wild fish.

Table 8 Results of regressions on LQ within fish categories on time (year) for each European country group over 20 years

		Germanic	Franco-Belge	Iberian	Anglo-Saxon	Mediterranean	Scandi	East	Europe
Wild CCS[1]	Trend	0.055***	0.056***	NS	NS	NS	0.064***	0.013***	NS
	(s.e.)	*(0.014)*	*(0.006)*				*(0.020)*	*(0.004)*	
Farmed CCS[1]	Trend	0.063***	0.064***	NS	NS	NS	0.080***	0.019***	NS
	(s.e.)	*(0.015)*	*(0.008)*				*(0.020)*	*(0.003)*	
Wild fish	Trend	0.056**	0.057***	NS	NS	0.042**	0.091***	NS	NS
	(s.e.)	*(0.021)*	*(0.018)*			*(0.015)*	*(0.018)*		
Farmed fish	Trend	NS	0.059**	NS	NS	0.038***	0.038***	0.020***	NS
	(s.e.)		*(0.023)*			*(0.006)*	*(0.007)*	*(0.004)*	
Freshwater fish[2]	Trend	0.085**	0.055**	0.059***	0.111**	0.055***	0.098***	NS	0.061***
	(s.e.)	*(0.022)*	*(0.013)*	*(0.017)*	*(0.045)*	*(0.009)*	*(0.029)*		*(0.014)*
Unspecified	Trend	0.18***	0.054***	0.026***	NS	0.035**	0.047***	NS	0.039***
	(s.e.)	*(0.021)*	*(0.006)*	*(0.009)*		*(0.016)*	*(0.014)*		*(0.005)*

Source: Authors' elaboration based on Mintel's GNPD data (2000-2019).

Note: Sig: *** 1%, ** 5%. Standard errors are in parentheses. The p-value of the joint F test for all the coefficients is less than 5% for all displayed estimations. NS means that either the results were not significant or that the p-value of the joint F test for all the coefficients was above 5%. Constants are not displayed for readability reasons, although all models included such values because a majority of estimations, AIC/BIC was optimized with a constant.

[1] Cephalopods, crustaceans, and shellfish.

[2] Due to the low number of new freshwater species products in the database, we did not distinguish between farmed and wild fish.

For freshwater and unspecified fishes, trends for organic and animal welfare were similar to the evolution of SC FAPs (Table 9), and none was significantly different from the growth of sustainability claims as a whole (Table 10). Only the share of sustainable packaging and EF raw

material increases faster than the share of SC unspecified products (Table 9). Nevertheless, this increase does not drive the market of SC FAPs (Table 10).

In all the country groups, the share of wild species with SC increased, which significantly contributed to the increase in sustainability claims (Table 7). However, the growth of SC wild fish was slightly faster than the growth of SC products only for the Germanic, Franco-Belge, Mediterranean and Scandi groups of countries (Table 8).

However, this finding does not mean that the fish itself came from sustainable sources. If we look at the evolution of claims within the wild fish species group in the last twenty years, it turns out that the share of EF raw material claims increased (1.833 – Table 9). However, the increase in the share of SC wild product was slower than the share of SC for FAPs (-0.899 - Table 10). Thus, for wild fish, this claim did not contribute significantly to the increase in the sustainable FAP trend. For this species category, only the share of sustainable packaging increased faster than the share of SC for FAPs (0.048 - Table 10). This finding highlights the fact that the sustainability of the resource is not necessarily ensured by sustainable FAP positioning.

Table 9 Regressions of the share of each sustainability claim over sustainable FAPs on time (year) for each species group over 20 years

		Wild CCS[1]	Farmed CCS[1]	Wild fish	Farmed fish	Freshwater[2]	Unspecified
Organic	*Trend*	NS	NS	NS	NS	NS	NS
	(s.e.)						
Sustainable packaging	*Trend*	2.689***	2.367***	2.634***	2.925***	NS	2.832**
	(s.e.)	(0.769)	(0.811)	(0.464)	(0.487)		(1.109)
EF raw material	*Trend*	4.632***	4.778***	1.833**	3.446***	5.601***	4.722***
	(s.e.)	(0.358)	(0.376)	(0.703)	(0.581)	(0.943)	(0.864)
Animal welfare	*Trend*	-2.901**	-2.732**	-2.840**	NS	NS	NS
	(s.e.)	(1.09)	(1.035)	(0.981)			

Source: Authors' elaboration based on Mintel's GNPD data (2000-2019).
Note: Sig: *** 1%, ** 5%, * 10%. Standard errors are in parentheses. The p-value of the joint F test for all the coefficients is less than 5% for all displayed estimations. NS means that either the results were not significant or that the p-value of the joint F test for all the coefficients was above 5%. Constants are not displayed for readability reasons, although all models included such values because for a majority of estimations, AIC/BIC was optimized with a constant.
[1] Cephalopods, crustaceans, and shellfish
[2] Due to the low number of new freshwater species products in the database, we did not distinguish between farmed and wild fish.

Table 10 Regressions of the LQ of products within sustainability claims on time (year) for each species group over 20 years

		Wild CCS[1]	Farmed CCS[1]	Wild fish	Farmed fish	Freshwater[2]	Unspecified
Organic	*Trend*	-1.163**	-0.835**	NS	-0.473***	NS	NS
	(s.e.)	(0.492)	(0.340)		(0.133)		
Sustainable packaging	*Trend*	NS	NS	0.048***	-0.065***	NS	NS
	(s.e.)			(0.014)	(0.020)		
EF raw material	*Trend*	0.085**	NS	-0.899***	NS	NS	NS
	(s.e.)	(0.039)		(0.236)			
Animal welfare	*Trend*	-0.818***	-0.631***	-1.136***	NS	NS	NS
	(s.e.)	(0.293)	(0.217)	(0.278)			

Source: Authors' elaboration based on Mintel's GNPD data (2000-2019).

Note: Sig: *** 1%, ** 5%. Standard errors are in parentheses. The p-value of the joint F test for all the coefficients is less than 5% for all displayed estimations. NS means that either the results were not significant or that the p-value of the joint F test for all the coefficients was above 5%. Constants are not displayed for readability reasons, although all models included such values because for a majority of estimations, AIC/BIC was optimized with a constant.

[1] Cephalopods, crustacean, and shellfish

[2] Due to the low number of new freshwater species products in the database, we did not distinguish between farmed and wild fish.

We found that EF raw product claims had a positive and significant impact on the sustainable market trend for one species: CCS wild (0.085 – Table 10). This result was very interesting because those species are not subject to quotas or are not even clearly specified to the consumer. These species are subject to minimum catch size or seasonal catching allowance, but there are no restrictions on the fished quantities[10]. Those species are generally not considered overexploited but rather are overspreading in their environment, and this abundance is rather representative of an environmental imbalance linked with their predator depletion. Therefore, on the European FAP market, the categories for which sustainability was driven by EF raw material claims (and not sustainable packaging, organic production, or animal welfare) are categories of species that do not suffer from overfishing. Because resources are not subject to environmental depletion, it is easier for the sector to promote sustainability. In contrast, the contribution of EF raw material claimed that wild fish products, which is fundamental for sustainability in resource management, decreased over time.

[10] Only Norway Lobster in this category is subject to quotas. In the database, Norway Lobsters are taken together with Lobsters due to identical commercial name across Europe. Both represents 7.21% of the CCS wild category.

As previously observed, claims related to organic production or animal welfare are not important drivers of sustainable information. The animal welfare share decreased over the period for wild and farmed CCS and wild fish (-2.901, -2.732, and -2.840, respectively - Table 9), and the contribution of those species to the SC market decreased (- 0.818, -0.631, and -1.136, respectively - Table 10). These species are more difficult to fit in animal welfare claims, which are more easily assigned to fish farming regulations (e.g., fish density). For organic claims, no species had a positive trend in the share of organic products (NS - Table 9), and even for wild and farmed CCS and for farmed fish, the contribution to the SC market of FAPs decreased over time (-1.163, -0.835, -0.473, respectively - Table 10). For wild species the claim about organic does not concern the fish raw material, but others components of the product not linked with the fisheries industries. Nevertheless, even for species that could be easily claimed to be organic, such as farmed products, this claim does not drive the market.

5.4. Discussion

The results indicated that the share of FAPs launched in the market with sustainability claims was increasing across Europe in all countries. However, the claims reflected different aspects of sustainability, and the sustainable path in Europe was mainly driven by sustainable products (EF raw material) and packaging. In addition, in France, Belgium, Spain and Portugal (major markets for FAPs in volume), only the share of sustainable packaging increased faster than the increase in SC FAPs. At the European level, organic and animal welfare were not market drivers of sustainability because the share of those claimed to increase slower than the share of SC FAPs.

In addition to differences in the use of sustainability claims by country, we observed differences among species. The impact of species stock evaluations (whether they are overexploited or not)

by scientists is an interesting subject, although classifying the fishes in the database as specific species was difficult or even impossible. Indeed, records with full *Latin names* of species were rare in the database; thus, we only had the general family. Nonetheless, using major species groups, we highlighted some heterogeneity in the market across species. Sustainability in countries in Eastern Europe was driven by farmed FAPs, whereas the farmed product market was driven by the sustainability of raw material and packaging. Indeed, in those countries, organic certification is considered irrelevant because a FAP from traditional farming is viewed as an ecological product (EUMOFA, 2017b), and the consumption of FAPs and organic products is below the European average. The market was driven by sustainability claims about wild fish in countries with high consumption of organic products and FAPs and higher sustainable consumption acceptance (UK, Scandi and Germanic). However, the driver of sustainability claims on wild fish was packaging, thus leading to sustainability positioning of the product to match consumer expectations that lacked real implications in terms of resource management.

The share of sustainability claims on the raw material, i.e., on the FAP itself, was mainly increasing over the studied period. However, it was a driver of sustainability only for wild CCS, while these species are not subject to quotas and do not face a strong pressure on stocks. For other wild species, it may be difficult for companies to emphasize fishery sustainability in a global environment, where the pressure is continually increasing on stocks (FAO, 2020; Gascuel, 2019). In these cases, it turns out that sustainability claims used by companies focused on the sustainability of the packaging and were not related to resource management.

Two consequences of the above results can be discussed: from consumer perceptive, SC succeed to inform about sustainability when there are no major issues on the resource management. From this point of view, claims are an efficient tool. Nevertheless, concerning the use of SC by firms

for species subject to resource constrains, claims do not seem to be tools favoring sustainable practices. Conversely, they may reach sustainable positioning in a less costly manner through sustainable packaging.

The database used aims to emphasize suppliers market tendencies, and it suffers from some limitations, as reflected in our analysis. First, the database is not exhaustive, and some products launched in the European market may not have been included in the database. However, all products, with and without claims, suffer the same bias, which reinforces the use of share and LQ as relevant analysis tools in this framework. Second, the lack of precision in regards of species identification limit our analysis. Third, the database included exclusively transformed products, and the sustainability of fresh FAP products is not considered. Less processed products with clear identification of the species can represent a method of promoting sustainability, and also because consumers of fresh FAPs are more concerned about sustainability issues (Brécard et al, 2009). We must keep in mind that our results only focused on the market of processed FAPs. Nevertheless, let us note that this market is important, dynamic, and driven by convenience issues too; and that it is difficult to get its sustainability attributes unless claims are added to inform consumers.

6. Conclusion and policy implications

To consider sustainability in their food choices, consumers need information because sustainability issues are credence attributes that need to be signaled at the point of sale. The difficulties of signaling the sustainability of food products are a major concern for producers, policy makers, and non-governmental organizations (Van Loo et al., 2014). In this framework, product claims are a useful tool. Sustainability claims need to be supported in all markets and for all attributes (packaging, product, organic, animal welfare), even if some claims aim to remain

niche markets. For the management of renewable resources, such as FAPs, policy makers need to support the development of sustainability claims directly related to the resource.

The share of FAPs with SC is increasing across Europe. In the last decade, this increase has been mainly driven by the use of claims related to the management of the resource (EF raw material) and the packaging, rather than by organic or animal welfare claims. Despite some differences across species, sustainability claims appear to be an efficient method of effectively promoting sustainable resources, not subject to overexploitation. In that situation, SC on raw materials drive the FAPs market when resource sustainability is not an issue. However, when sustainable management of the resource becomes more complex, sustainability on raw materials do not leverage the touchpoint strategy.

Overall, the use of sustainability claims was largely used in the market to answer consumer expectations in terms of sustainability. However, consumer expectations are complex, and the use of sustainability claims puts environmental issues in competition with the other attributes that are taken into account in consumer decision-making. Even if major issues such as overfishing are not the central driver of sustainability claims in the FAP market, the observed trends highlight consumer demand for more environmentally friendly products.

Either demand or supply drives the market trend, and incentives must be implemented on both sides. All consumers need to be informed about general environmental issues. Policymakers need to support initiatives to raise consumers' awareness of the sustainable management of FAPs, especially in countries with a slower increase in the share of sustainable FAPs, e.g., eastern countries and the majority of Mediterranean countries.

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ANNEX:

Table A.1 Table of claims classification

Natural	Sustainable	Convenience	Health	Sociodemo	Fairtrade	Other
All natural product GMO free Hormone free No additives/preservatives Whole grain	Carbon neutral Ethical – env. friendly packaging Ethical – env friendly product Organic Ethical – animal welfare	Convenient packaging Ease of use Microwaveable On-the-go Portability Time/speed Rechargeable	Added calcium Anti-aging Antioxidant Diabetes compatible Low/no/reduced High fiber Functional – cardiovascular Functional – digestive Functional – brain & nervous system Functional – bone health Vitamin/mineral fortified Gluten free Immune system Prebiotics Sterols/stanols	Babies & toddlers (0-4) Children (5-12) Halal Kosher For men For women Vegetarian Vegan	Ethical – human Ethical – charity	Slimming Cobranded Innovative packaging Functional – other Functional – beauty High satiety High protein Innovative ingredient Social media Merchandising Original Premium Seasonal Economical Limited edition Weight & muscle gain
Number of products in each claim category						
5,599	12,046	9,554	4,358	674	276	5,542

Note: Over 34,215 FAPs.

Table A.2 – Percentage of Sustainable claims by claims and by species.

Species	Number of products with at least one sustainability claim	Percentage of SC products with carbon neutral claims	Percentage of SC products with organic claims	Percentage of SC products with environmentally friendly packaging	Percentage of SC products with environmentally friendly product	Percentage of SC products with animal welfare
All Species	**12,046**	**0.14**	**9.86**	**38.08**	**69.98**	**21.91**
Bluefish	892	0.00	14.01	56.73	48.43	3.03
Trout	230	0.87	34.78	36.52	52.61	13.04
Cephalopods	217	0.00	9.68	59.45	38.71	4.61
Herring	513	0.00	5.46	9.94	94.35	2.14
Cod	1,017	0.10	3.93	48.28	78.86	3.05
Crustaceans	1,747	0.00	11.22	34.97	64.68	12.71
Flatfish	174	0.00	1.72	27.01	90.23	2.30
Haddock	234	0.00	0.85	67.09	63.68	7.26
Shellfish	312	0.32	3.85	61.22	42.31	7.05
Mussel	283	0.00	9.54	55.12	51.94	3.18
Pollock	1,225	0.41	2.29	41.80	86.37	4.16
Salmon	2,708	0.30	18.17	41.10	62.04	15.51
Tuna	2,484	0.00	4.19	26.53	77.42	73.91
Seafood	796	0.25	7.04	50.75	57.66	10.80
Freshwater Fish	258	0.00	12.02	20.93	80.62	5.04
Other fish (species specified)	179	0.00	8.38	40.78	64.25	7.82

Note: Nb Obs: 34,215 products and 12,046 products with at least one environmental claim. Reading key: Among the sustainable products containing bluefish, none had carbon claims, 14.01% had organic claims, 56.73% had environmentally friendly packaging claims, 48.43% had environmentally friendly product claims and 3.03% had animal welfare claims. Source: Authors' elaboration based on the GNPD (2000-2019).

Table A.3 – Top 10 firms introducing products with at least one sustainability attribute

Firm	Firm Type	Firm nationality	*Storage*			Total (frequency %)	Rank of the firm overall	
			Fresh	*Frozen*	*Ambient*		SC FAPs	All FAPs
Lidl	Retailer	Germany	279	269	150	698 (5.79%)	1	1
Marks & Spencer	Retailer	UK	545	53	27	625 (5.19%)	2	2
Tesco	Retailer	UK	176	83	92	351 (2.91%)	3	3
Aldi	Retailer	Germany	71	131	105	307 (2.55%)	4	4
Iglo	Manufacturer	UK	*Ø*	294	*Ø*	294 (2.44%)	5	6
Waitrose	Retailer	UK	172	61	29	262 (2.17%)	6	8
Findus	Manufacturer	UK	*Ø*	218	*Ø*	*218 (1.81%)*	7	5
Bolton Alimentari	Manufacturer	Italy	*Ø*	*Ø*	185	185 (1.53%)	8	10
Young's	Manufacturer	UK	22	152	*Ø*	174 (1.44%)	9	16
Sainsbury's	Retailer	UK	86	40	40	166 (1.38%)	10	11
	Manufacturer		1,838	2,118	2,515	6,471 (53.72%)		
	Retailer		2,461	1,868	1,246	5,575 (46.28%)		

† Findus and Iglo have both been the property of Normad Foods in Europe since 2015, but as the data used are from 2000 and 2019, we will continue to distinguish both firms. Number of observations: 12,046 products with sustainability claims, *Ø* means no observation. Source: Authors' elaboration based on the GNPD (2000-2019)

Table A.4 – Classification of fish species by main species category

Species	Detailed species
Fish wild	Bluefish, marlin, smelt, Sebastes, capelin, Bramidae, wolffish, anchovy, mahi mahi, tuna, black scabbardfish, herring, swordfish, Clupeidae, mackerel, barramundi, cod, haddock, dory, pollock, hake, Lutjanidae, hoki, Scorpaenidae, halibut, vendace, Mugilidae, escolar, lumpfish, shark, monkfish, flatfish
Fish farmed	Trout, seabass, char, salmon
Freshwater fish (beside Salmon and trout)	Pike, zander, perch, pangasius, tilapia, bream, sturgeon, carp, catfish, eel
Cephalopods, crustaceans & shellfish wild	Cephalopods, crab, crustaceans, urchins, lobster, mollusks
Cephalopods, crustaceans & shellfish farmed	Mussels, oysters, shrimp
Seafood (Unspecified species)	Fish, seafood, surimi, roe, tarama, seaweed

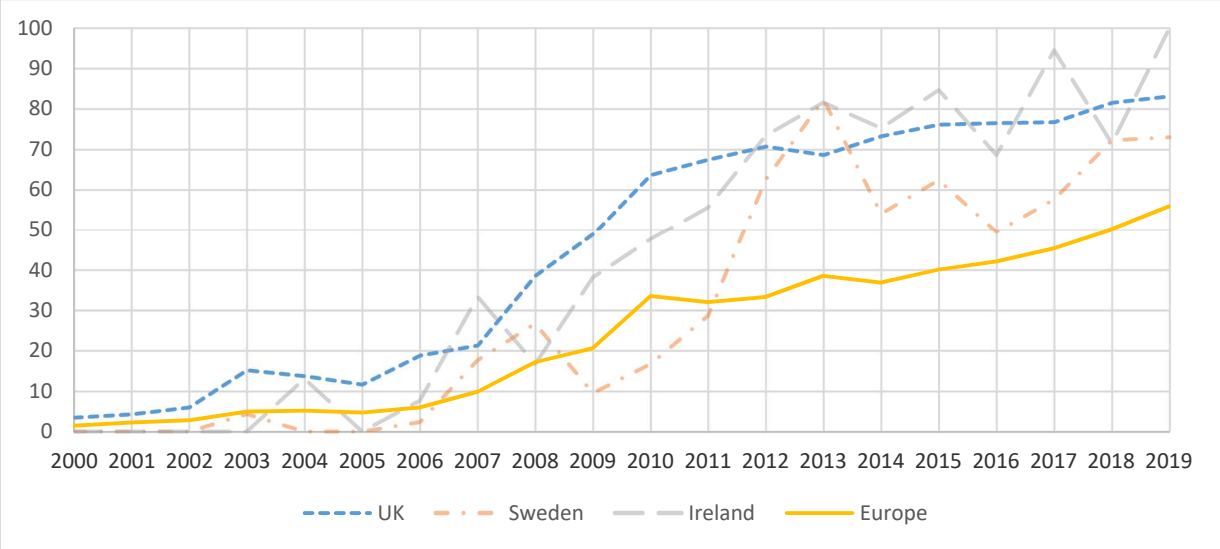
Note: Some choices have been made regarding seabass and seabream (regrouped under seabass) to include them in farmed categories. However, the major production of seabass comes from aquaculture (94% at the EU level, data for 2016 (EUMOFA, 2019a)).

Table A.5 – Construction of country groups by FAPs consumption and Environmental consciousness across Europe.

Country	FAP consumption (kg live weight/capita) 2018[1]	Environmental consciousness[5]	Group
Europe	24.36	21%	
Austria	13.12	44%	Germanic
Netherland	20.90	22%	Germanic
Germany	14.50	21%	Germanic
Switzerland	9[2]	ø	Germanic
France	33.52	28%	Franco-belge
Belgium	22.86	21%	Franco-belge
Spain	46.01	16%	Iberian
Portugal	60.92	9%	Iberian
Ireland	23.13	27%	Anglosaxon
United Kingdom	22.10	22%	Anglosaxon
Croatia	19.19	18%	Mediterranean
Greece	19.85	17%	Mediterranean
Italy	31.02	13%	Mediterranean
Sweden	26.61	60%	Scandi
Denmark	39.83	48%	Scandi
Finland	25.56	31%	Scandi
Norway	52.08 (2013)[3]	ø	Scandi
Slovakia	9.27	19%	East
Czech Republic	5.60	18%	East
Poland	13.02	14%	East
Romania	7.99	13%	East
Hungary	6.12	12%	East
Belarus	16.2(2016)[4]	ø	East
Bulgaria	7.00	ø	East
Estonia	9.71	ø	East
Latvia	6.80	ø	East
Lithuania	13.78	ø	East
Serbia	5.8 (2013)[3]	ø	East
Slovenia	11.69	ø	East
Ukraine	11.7 (2017)[4]	ø	East
Russia	22.93 (2013)[3]	ø	East
Turkey	4.9 (2016)[4]	ø	East

Note: (1) EUMOFA (2020); (2) EUMOFA (2019b); (3) FAOSTAT, 2021 (4) Fisheries and Aquaculture country profiles. FAO website (2021) FAO (2019) (5) Percentage of positive answer to the question: "Have you done any of the following for environmental reasons in the past month? (Recycled, cut down your energy consumption, cut down your water consumption, chosen local products, reduced waste, bought environmentally friendly products marked with an environmental label, used your car less)". ø = no included in the survey. Source: Eurobarometer, 2014;

Graphic A.1 Share (%) of FAPs with sustainable claims over FAPs products from 2000 to 2019.



Note: number of observations: Europe 34,215 products including 12,046 with at least one SC; UK 4,198 products including 2,428 with at least one SC; Ireland 538 products including 341 with at least one SC; Sweden 665 products including 278 with at least one SC Source: Authors' elaboration based on the GNPD (2000-2019)