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Fisheries and aquaculture products consumption in France: when the Covid-19 crisis did not lead to more sustainable purchases

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Abstract – In terms of food consumption, sustainability dimensions are often conflicting with purchasing power and practical purchases. France lands, farms, imports, and consumes large quantities of fisheries and aquaculture products (FAPs). The pandemic affected both domestic and foreign FAP supply through restrictions on trade and fishing conditions. Numerous sale points offering FAPs were closed during the pandemic. This general context has likely questioned the role of consumers on environmental, economic, and social matters. The aim of the paper is to assess whether the Covid-19 crisis has been an opportunity for French consumers to align their consumption at-home with the environmental issues by favouring domestic producers, short channels, or eco-friendly products. Quantitative data on at-home ordinary household purchases in metropolitan France from 2017 to 2021 was used along with t-test methods. It seems that fresh FAPs consumption did not truly adapt to the domestic fish production in defiance of import restrictions and available surpluses. While fresh shellfish at-home consumption did not change significantly in 2020, salmon and cod are still widely favoured by French consumers at-home, although their French production is virtually non-existent. On the contrary, domestically produced fish species remains poorly consumed at-home. The abundant supply of fresh salmon initially intended for other markets has permitted to consolidate the dominant position of this species on the French at-home consumption market. Initiated by supermarkets and hypermarkets and followed up by consumers, the trend of purchasing pre-packaged fresh fish has been substantially amplified by the pandemic and seems to persist over time.

Keywords: COVID-19 / seafood / fishery and aquaculture products (FAPs) / sustainable consumption

1 Introduction

Food consumption, including Fisheries and Aquaculture Products (FAPs), can easily illustrate concerns about food sovereignty. Moreover, the environmental problems linked with fisheries and aquaculture production methods such as overfishing, disturbance to the seabed, and loss of biodiversity could be offset by consumers' choices when buying food.

The concept of 'sustainable consumption' does not have a formal definition. According to Grunert (2011), this concept is partially covered via food labelling relating to organic agriculture, environmental protection, fair trade, animal welfare, carbon footprint, local production, healthiness, etc. Consequently, a trade-off between sustainability and accessibility¹ may arise in consumers' choices. The use of short distribution channels

together with the desire to favour domestic production can be supported by consumers and incentivise more sustainable production methods. In France, a trend favouring local products and shorter distribution channels is becoming more and more widespread (FranceAgriMer, 2021b; Francois-Lecompte et al., 2021; Ugaglia et al., 2021). By nature, short distribution channels do not depend on international trade and logistics. Thus, the closure of a large part of the economy may not have threatened their activities. During the first lockdown, consumers sought geographical proximity of sale points through short food circuits or proximity stores (Cavallo et al., 2020; Hollandts, 2020). Additionally, 78.9% of French households report they try to buy local products as often as possible. However, in practice, the evolution of expenditure is only +14.4% for direct sales and +7.4% for small- and medium-sized enterprises (SME) products (Rousselin-Rousvoal, 2022). This may illustrate a potential gap between consumers' declarations and actions.

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¹ Price, practicality, and feasibility of purchases.

Nonetheless, noticeable changes in consumption behaviour have been observed in Europe following the pandemic. For example, in Italy, Portugal, Denmark, Poland, Austria, United Kingdom, Germany, and Slovenia, the shopping frequency was reduced together with an increase of long shelf life product consumption as well as more processed products (Cavallo et al., 2020; Janssen et al., 2021; Martins et al., 2022; Skotnicka et al., 2021). Thus, observing similar phenomena concerning FAP consumption could be expected in France.

The pandemic led to the closure of hotels, restaurants, and catering (HORECA) during and beyond lockdowns, in addition to numerous food sale points. Consumers are moving towards greater consumption of long shelf-life products (FAO, 2012; FranceAgriMer, 2021b; Kantar, 2020; Richards and Rickard, 2020) and often highly processed (IPES-Food, 2020). Thus, the demand for fresh food² has been substituted by processed products with longer shelf life (FAO, 2012; Janssen et al., 2021). Additionally, the perceived food prices have increased during the pandemic, coinciding with a perceived decrease in purchasing power (FranceAgriMer, 2021b). Consumers are still mainly concerned about prices, health benefits, information available, and convenience in their purchasing acts (DG and MARE, 2021; Herve and Marchenay, 2021).

In order to cope with a perceived loss of purchasing power, following the Covid-19 crisis, consumers may adopt some compensatory strategies involving a change in distribution channels and product quality, such as the choice of discounter channels and favouring store brands (Bertrandias and Lapeyriere, 2015). Moving away from the 'hard discount' model where only low prices matter, discounter channels have been adopting a 'soft discount' strategy for several years. Many of these sale points have been reorganised in order to offer a different product range, of better quality while maintaining good money value. This new offer materialises in a wide variety of fresh products, including fresh FAPs (Simonnet, 2021).

FAPs are among the most traded food products in the world (FAO, 2021) and are strongly regulated by the EU (Common Fishery Policy regulating both fish stock exploitation and EU markets for fishery products), in contrast with other imported products. At the European level, France is one of the largest FAPs consumers and producers, specifically in terms of fresh FAPs (EUMOFA, 2020; STECF, 2020). Despite significant domestic production, this sector heavily depends on EU imports (FranceAgriMer, 2020a). Indeed, the most commonly consumed fish species are not always produced in France (see Tab. 1).

The fear of contamination by the food consumed (Martins et al., 2022) and in the sale points together with heavy movement restrictions during the lockdowns are breeding grounds for a shift in consumption habits (Di Renzo et al., 2020; Gorska et al., 2021; Janssen et al., 2021; Palau-Saumell et al., 2021). In addition to this restrictive and anxiety-inducing context, fresh FAPs are very sensitive to logistical constraints such as short shelf life and a strict necessity to be gently handled and transported. Thus, due to these constraints and given the large number of small vessels/firms and species

landed/farmed in France (Kalaydjian and Bas, 2022), this paper focuses on fresh FAPs (fresh fish and shellfish from fisheries or aquaculture production). We consider 'domestic/national consumption' through primary domestic supply³ or, in other words, domestic catches and farmed products.

The significant reduction in fresh FAPs imports along with the restrictive fishing conditions caused by the pandemic affected both domestic and foreign supply (EUMOFA, 2020). The FAP sector has been subject to logistical problems, particularly due to the restrictions encountered at the borders (FAO and Worldfish, 2021). Markets outside the EU were closed, as a result, products could not enter from third countries and external markets were closed to EU products (EUMOFA, 2020). Simultaneously, the fishing activity was reduced by 50–60% during the first weeks of the first lockdown (Guyader et al., 2021). Compared to 2019, the decreases in quantities sold at fish auctions represented 11% in 2020 (FranceAgriMer, 2021a). It appears the French food system adapted pretty quickly to the shock (Chiffolleau et al., 2021) and the FAP processing industry has been only slightly affected by the pandemic (Pititto et al., 2021).

Thus, the French framework offers a relevant approach to studying the fresh consumption of FAPs during the Covid-19 crisis. This paper investigates how far the Covid-19 crisis has been an opportunity for French consumers to contribute to environmental and food sovereignty issues by increasing the part of fresh domestic production in their at-home consumption of fresh FAPs. Based on a large dataset of FAP at home consumption purchases from 2017 to 2021, it reports the detailed features of fresh FAPs home consumption in 2020 compared to the previous years. As the origin of each product is not recorded in the database, we will consider the origin of the products by estimating their primary domestic production (see Tab. 1). In addition, issues relating to the distinction between fisheries and aquaculture and to sustainable labels will not be addressed in this report due to the lack of available data. Then, it focuses on consumer habits in terms of distribution channels and product presentation during the Covid-19 crisis in order to assess their potential willingness to change their consumption patterns in a sustainable way.

2 Materials and methods

Two main sources of information are available and used for this work:

- The FAP household purchases at home from the Kantar panel data. Kantar belongs to WPP Group, it intends to produce databases from various consumer panels, extracted on a continuous basis. Their field of work is varied and includes consumer goods, beauty products, fashion, telecommunications, entertainment, etc.
- The population of interest for this study is French households. The database used concerns ordinary household purchases at-home in metropolitan France via aggregated variables from 2017 to 2021. Those variables are related to a wide range of FAPs and extrapolated to the French population (see Tab. 2). The data collected by

² Both at-home and in restaurants.

³ mostly fresh products with little to no transformation.

Table 1. Apparent Fishery and Aquaculture Products consumption by species in France – 2017 estimates.

	Consumption (Kg/inhabitant)	Aquaculture (In %)	Production/consumption (In %)	Species available in the dataset
<u>Fish species</u>				
Tuna	3.1	0	51	Yes
Salmon	2.89	98	0	Yes
Cod	2.84	0	6	Yes
Alaska pollack	2.30	0	0	Yes
Hake	1.04	0	65	Yes
Pilchard	1.09	0	36	Yes
Mackerel	0.87	0	40	Yes
Saithe	0.69	0	33	
Atlantic herring	0.65	0	66	
Trout	0.48	100	106	Yes
Monkfish	0.45	0	80	Yes
Seabream	0.24	75	30	
Seabass	0.14	62	43	Yes
Sole	0.09	1	80	Yes
<u>Shellfish species</u>				
Shrimps	1.9	70	1	Yes
Mussels	1.9	98	37	Yes
Oyster	1.1	100	106	Yes
Scallops	1.1	30	38	Yes
Nephrops	0.2	0	28	Yes

Source: 2020 FranceAgriMer consumption report, Compiled by Sophie Girard (FORESEA Project, 2021).

Table 2. Description of home consumption variables (extrapolated to the French population).

	Description	Unit	Used for the PCA
<u>Available variables</u>			
Amount spent	Households expenditures	€*	
Quantities purchased	Households purchased quantities	Kg ¹	
Market penetration	Ratio of purchasing households	%	
Number of purchasing act	Total number of purchasing acts by households	N	
Number of re-buyers	Total number of re-purchasing households	N	
Number of households	Total number of households annually estimated	N	
Average price	Amount spent over quantities purchased	€*	Yes
<u>Constructed variables</u>			
Amount spent per purchasing act	Amount spent over number of purchasing acts	€	Yes
Quantities purchased per purchasing act	Quantities purchased over number of purchasing acts	Kg ¹	Yes
Number of purchasing households	Number of households multiplied by the market penetration	N	
Repurchase rate	Number of re-buyers over the number of purchasing households	%	Yes
Ratio sold in Generalised Dist. Channels	Amount spent in generalised Dist. Channels over the Amount spent in total France	%	Yes
Variance of market penetration	Monthly market penetration variances as a proxy for products seasonality	N	Yes

NB: The variables are available on a given product in a given time period and a given distribution channel.

*Adjusted by 2015 annual and monthly INSEE Consumer Price Index of all items in France.

¹Net weight.

Kantar via its panel are extrapolated to the entire French population and this extrapolation only makes sense when the **market penetration**, defined as the proportion of purchasing households for a given product⁴, is sufficient. Kantar has set this threshold by convention at 2%. For a given period and a given distribution channel, each observation of the dataset corresponds to one product. Observations materialise a combination of detail including species⁵ and packaging (fresh salmon, frozen cod, canned tuna, etc.). Some products are not associated with a species, for example, fish preparation products are rarely linked to a separate species. In addition, broad categories of FAPs mixing several species such as ‘fresh fish’ are available. The available data cover most of the key species in French consumption (see Tab. 1) and count more than 60 distinct products⁶.

- The database is divided between observations on fresh products (without barcode), obtained from 12,000 households, and observations on products with barcode grouping⁷, obtained from 20,000 households. The panel is constructed according to the socio-demographic criteria of the National Institute of Statistics and Economic Studies INSEE in order to ensure the representativeness of the French population. As said before, product data can be considered ‘exploitable’ and thus be included in the analysis only if at least 2% of households purchase this product for a given period. Households in the panel report their weekly home consumption purchases along with the distribution channels used⁸. Monthly and annual data are available from 2017 to 2021 and in 2021, data cover only January, February, and March.
- The distribution channels are constructed by Kantar. This classification (Generalised vs Specialised) opposes distribution channels proposing food as well as other non-alimentary items against those specialised in food products only.
- Several distribution channels are considered as generalised: *hypermarkets* and *supermarkets* are large shopping centres located on the outskirts of cities. *Supermarkets* sizes vary between 400 m² and 2,500 m² whereas *hypermarkets* are defined as over 2,500 m². *Proximity shops* are defined by their small size (less than 400m²) and their location in the city centre. *Discounters* or Dominantly Owned Brand retailers are selected based on their low pricing strategy. *Online distribution channels* refer to drive and/or home delivery retailers from large hyper/supermarket chains or internet retailers.
- *Specialised distribution channels*⁹ include: *fishmongers* small-scale retailers specialised in seafood, *markets/fairs*, temporary markets held at regular intervals at the same location. *Fresh supermarkets* propose fresh and local products by subcontracting their shelves to independent

traders and producers. *Freezer centres* are specialised in the sale of frozen food products. Many other *Specialised distribution channels* are covered by the dataset but are either not significant/ relevant for FAPs.

- The imports/exports FAPs from the COMEXT database. The monthly data extracted from Eurostat database are available online. Data aggregation is based on FranceA-grimer FAPs classification (fresh, canned, smoked, etc.). The dataset contains aggregated monthly imports/exports of FAPs by species to/from France.

The method is based on the comparison of the purchase behaviour looking at each variable before (2017–2019) and during the Covid-19 crisis (2020, beginning of 2021) on monthly and annual timeframes:

- The monthly timeframe was considered to compare the two lockdowns in 2020 with their counterparts from 2017 to 2019. The 1st lockdown corresponds to the months of March, April, and May 2020, and the second one to the months of November and December 2020. Descriptive statistics and data visualisation (ggplot2 R package;) were used in addition to a two-tailed t-test (t.test in stats R package; to compare whether lockdowns means were significantly different from the 2017–2019 means. F tests (var.test in stats R package;) were also used to compare the variances of the means. When two variances are considered equal, the pooled variance is used to estimate the variance. The Student *t* statistic to test whether the means are different can be calculated as follows (assuming and follow a normal distribution):

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

According to Overall et al. (1995), if the equality of variances of the means is rejected, the Welch t-test should provide more accurate results. The Welch *t* statistic can be calculated as follows (assuming \bar{X}_1 and \bar{X}_2 follow a normal distribution):

$$t_{Welch} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{s_{\bar{X}_1}^2 + s_{\bar{X}_2}^2}} \quad s_{\bar{X}_1} = \frac{s_1}{\sqrt{n_1}} \quad s_{\bar{X}_2} = \frac{s_2}{\sqrt{n_2}}$$

where s_1 and s_2 correspond to the first and second sample means’ standard deviations, n_1 and n_2 the sample sizes.

t-tests for the first lockdown: For each variable considered, \bar{X}_1 be the mean value for the months of March, April, and May 2020 for the first lockdown and \bar{X}_2 the mean value of the months of March, April, and May 2017, 2018 and 2019.

t-tests for the second lockdown: For each variable considered, \bar{X}_1 be the mean value for the months of November, and December 2020 for the first lockdown and \bar{X}_2 the mean value of the months of November, and December 2017, 2018, and 2019.

Furthermore, statistical correlation tests (excel Pearson function) were performed in order to provide additional

⁴ For a given period and distribution channel.

⁵ When available.

⁶ Each accessible at various levels of detail.

⁷ Including chilled products.

⁸ The dataset does not allow for monitoring the decline of purchases of national/local products and labels.

⁹ Those channels are poorly defined/represented in the dataset.

evidence of a substitution effect between two different products. The Pearson correlation test measures the strength and the linear relationship between two variables/data sets (Benesty et al., 2009). The correlation coefficient is always between -1 and 1 . The closer a correlation coefficient is to $|1|$, the stronger the linear relationship between the variables under consideration. On the contrary, a value close to 0 implies that there is no linear dependence between the variables. Finally, the sign of the coefficient indicates whether the linear relationship is positive or negative.

- The annual timeframe was considered in order to compare 2020 from 2017 to 2019. Similar to the monthly timeframe, descriptive statistics and *t*-test mean differences were performed every month from 2017 to 2019 and then compared with every month of 2020.

t-tests for 2020: For each variable considered, be the mean value for the 12 months of 2020 for the first lockdown and the mean value of the 12 months of 2017, 2018, and 2019.

- FAPs are conventionally ordered according to their packaging or/and, species and the descriptive statistics followed this format. However, FAPs can be gathered according to common features in terms of purchase variables. Further to the descriptive approach, it is suggested to consider clusters of FAPs according to purchase variables and compare the evolution of these clusters between 2017–2019, and 2020. The Principal Component Analysis (PCA) is a multivariate statistical method, which consists of transforming related variables into new variables that are decorrelated to each other. This allows information to be summarised by reducing the number of variables. FactoMineR R package was used to perform the different PCA (Husson and Le, 2011). In this case, patterns are captured within clusters as well as trends between clusters created with 2017–2019 data and 2020 while dimensions (different variables used) are greatly reduced allowing for easier interpretations.

3 Results

3.1 Monthly results of fresh FAPs during the restriction periods

During the first lockdown, all distribution channels considered, several variables indicate a significant decrease in at-home consumption of fresh fish. Although there are no significant differences in terms of the *amount spent*, the *quantities purchased* decreased significantly by 7% (see Tab. 3). On the other hand, *average prices* and *amount spent per purchasing act* increased by 7.4% and 10.4%. Results differ concerning the second lockdown, we can observe an increase in the *amount spent* and *quantities purchased* of 12.2% and 12.7%.

Looking in detail at the type of distribution channels, we found some differences between *generalised* and *specialised distribution channels* (see Fig. 1). The *amount spent* for fresh fish in *generalised distribution channels* did not significantly change during the first lockdown. However, *quantities*

purchased decreased by 6.6%. Hyper/supermarkets have absorbed the majority of this diminution, whereas *discounters* registered an increase of *quantities purchased* of 69.6%.

Surprisingly, it seems that *Specialised distribution channels* were not significantly less favoured in terms of value and volume for the purchase of fresh fish during the first lockdown. However, one observes an increase of 26.4% in terms of *amount spent* for at-home fresh fish consumption. The second lockdown may have finally triggered greater sensitivity towards *Specialised distribution channels* such as *fishmongers* and *markets/fairs*. However, this phenomenon is negligible relative to the at-home French consumption scale.

As for fresh fish, the impact on fresh shellfish differs between lockdowns, but in the case of shellfish, the difference is more marked. During the first lockdown, fresh shellfish at-home consumption significantly decreased by around 28% in terms of *amount spent* (see Tab. 3). There was a significant drop in *market penetration* in *Hypermarkets* and *specialised distribution channels*. The impact on *Hypermarkets* is of the same order of magnitude for both volumes and values consumed at-home. During the second lockdown, no significant change in at-home consumption was observed on any distribution channels. After the first lockdown, fresh shellfish consumption has continued with business as usual. The first lockdown took place during the off-peak season for shellfish consumption whereas the second lockdown coincided with shellfish peak season consumption (FranceAgriMer, 2020b). Indeed, oysters (51% of purchased quantities), mussels (31%), and Scallops (8%) compose the majority of fresh shellfish consumed in France. Traditionally, Oyster and Scallops' home consumption in France increased considerably during Christmas and New Year's Eve in December (second lockdown). Data suggest that consumers did not substitute those products with others during those end-of-year celebrations. Considering the first lockdown not being linked to any particular consumption pattern, we believe that consumers decrease shellfish consumption more easily. Additionally, shellfish are usually stall-served. During the first lockdown, stall-serving was closed in many places (including some *generalised distribution channels*, all *open-air markets*, and some *fishmonger shops*) making the purchasing of fresh shellfish complicated. The primary domestic supply of fresh shellfish from aquaculture is considerable in France, allowing for both reactivity and flexibility.

Taking a look at the impact with respect to the level of transformation of FAPs, we can underline the amplification of an existing trend regarding pre-packaged food. Pre-packaged food is a type of packaging made available to consumers directly on the store shelves. It ensures the safety/hygiene of food products (e.g. the fear of contamination), allows for reducing interactions, and lowers the time spent shopping. Additionally, pre-packaged products contain use-by-date, important information for consumers. In contrast to stall-served fresh FAPs, pre-packaged fresh FAPs can be offered in many sale points with refrigerators¹⁰. Most likely initiated by *generalised distribution channels* several years ago, the sudden increased demand for pre-packaged fresh FAPs has

¹⁰ *Discounters, proximity shops, and online distribution channels* for example.

Table 3. Home consumption of fresh fish and shellfish during lockdowns per distribution channel in France.

	Fresh Fish		Fresh Shellfish	
	First lockdown % Rate of change	Second lockdown % Rate of change	First lockdown % Rate of change	Second lockdown % Rate of change
<u>Amount spent</u>				
Total France	-0.21	+12.2***	-28.51*	+1.17
Generalised Dist. Channels	+0.85	+7.5**	-28.28*	-3.12
<i>Incl. Hypermarkets</i>	-7.4**	+6.74	-35.43**	-3.23
<i>Incl. Supermarkets</i>	-0.29	-8.88*		
<i>Incl. Discounters</i>	+67.17***	+83.12***		
Specialised Dist. Channels	-3.72	+26.39***	-28.89	+10.64
<u>Quantities purchased</u>				
Total France	-7.04*	+12.71*	-28.59	+3.42
Generalised Dist. Channels	-6.57*	+7.7	-27.81	-0.64
<i>Incl. Hypermarkets</i>	-12.79*	+6.89	-35.3*	-3.51
<i>Incl. Supermarkets</i>	-10.09	-7.37		
<i>Incl. Discounters</i>	+69.62***	+92.41***		
Specialised Dist. Channels	-8.97	+31.82	-30.3	+13.42
<u>Average Prices</u>				
Total France	+7.38***	-0.39	-0.1	-1.46
Generalised Dist. Channels	+7.97***	-0.13	-1.63	-2.31
<i>Incl. Hypermarkets</i>	+6.24***	-0.22	-0.73	+0.69
<i>Incl. Supermarkets</i>	+10.93***	-1.2		
<i>Incl. Discounters</i>	-1.78	-5.06*		
Specialised Dist. Channels	+5.68*	-3.93	+3.86	-1.41
<u>Market penetration</u>				
Total France	-4.46	+7.83	-20.54	+5.21
Generalised Dist. Channels	-2.51	+5.78	-18.85	+2.76
<i>Incl. Hypermarkets</i>	-10.82**	+2.38	-25.6*	+2.05
<i>Incl. Supermarkets</i>	-3.16	-11.33		
<i>Incl. Discounters</i>	+45.07***	+69.28***		
Specialised Dist. Channels	-11.76*	+20.82**	-25.1*	+12.98
<u>Amount spent per purchasing act</u>				
Total France	+10.47***	+5.45	-4.58	-2.72

Student's *t*-test/Welch's *t*-test, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Comparison between March, April and May 2017–2019 (9 observations) and 2020 (3 observations) for the first lockdown.

Comparison between November and December 2017–2019 (6 observations) and 2020 (2 observations) for the second lockdown.

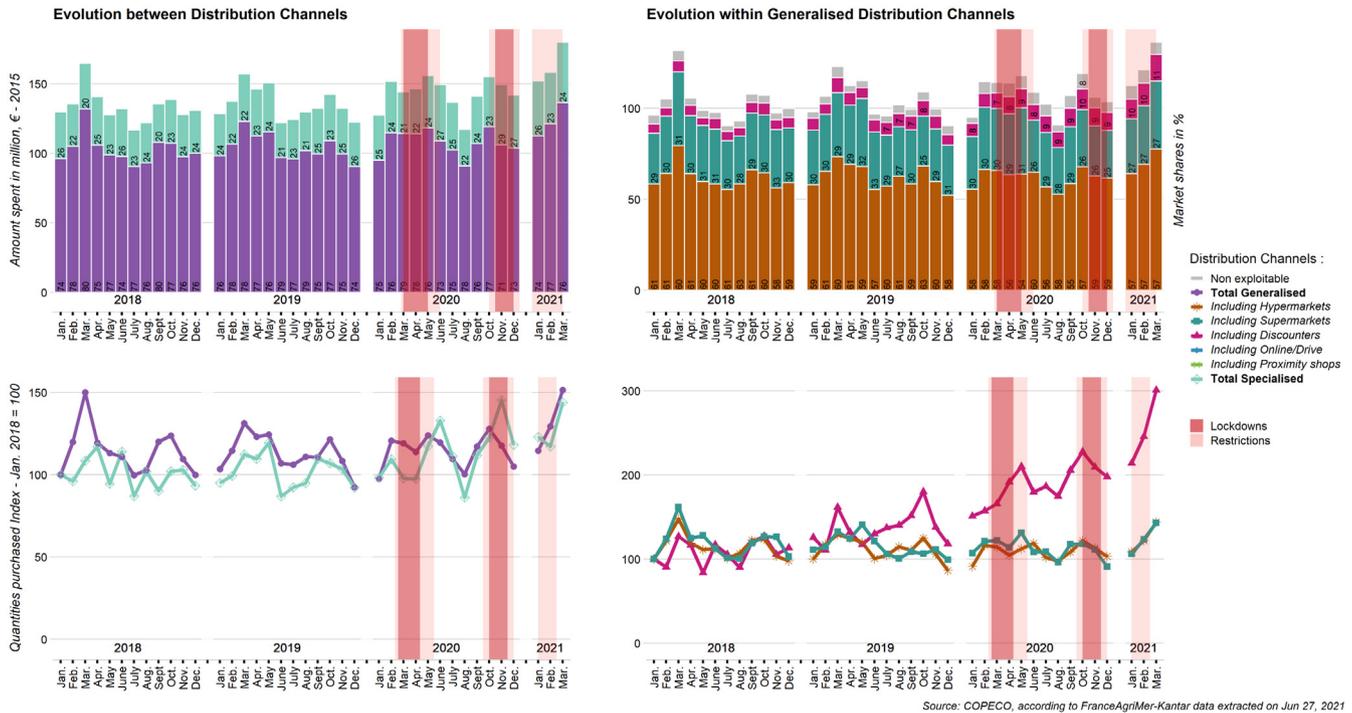
Monthly data extracted on 27/06/21, source: COPECO, based on FranceAgriMer-Kantar data.

ultimately begun to meet the abundant supply since the first lockdown. This trend appears to persist over time for fresh fish and pre-cooked shrimps.

Data shows a significant increase in consumption of pre-packaged fresh fish during the first lockdown. It represents 41.2% in volume and 44.2% in value for all distribution channels combined (see Tab. 4). When comparing the *average prices* per kg of pre-packaged versus stall-served fresh fish, the latter is less expensive (see Fig. 2) and it stands in every *generalised distribution channel* (see Fig. 3). The *amount spent per purchasing act* for pre-packaged fresh fish is significantly lower than stall-served fresh fish. Considering that consumers perceive prices through the *amount spent per purchasing act*, rather than the amount spent per kg or *average*

prices, it is reasonable to assume that consumers wrongly consider pre-packaged fresh fish as a 'cheaper' alternative. In a context where consumers feel limited by low purchasing power, this phenomenon is quite paradoxical. Simultaneously, *discounters* have known a real breakthrough for fresh fish at-home consumption. Fresh fish sold in *discounters* are systematically pre-packaged. Considering an equivalent quality, pre-packaged fish is on average €3.3 cheaper per kg (€14.9 vs €18.2) in *discounters* than in *supermarkets*. During the pandemic, this strategy worked for pre-packaged fresh fish, as the quantities sold in *discounters* exceeded those sold in *supermarkets*.

Several effects have been found to be specific to the first lockdown: a substitution effect between pre-packaged and



Source: COPECO, according to FranceAgriMer-Kantar data extracted on Jun 27, 2021

Fig. 1. Evolution of home consumption by Distribution Channel for fresh fish in France.

stall-served FAPs, an unusual evolution of the consumption of long shell life FAPs, and a substitution effect between fresh and frozen fish.

The closing of numerous FAP stalls¹¹ mechanically led to a significant decrease in consumption of this selling mode during the first lockdown. Simultaneously, *average prices* of stall-served fresh fish increased significantly by 5.9% during the first lockdown¹² (see Tab. 4). It leads to a substitution effect between pre-packaged and stall-served FAPs, specific to the first lockdown. Additionally, correlation tests between different products' consumption¹³ could allow us to better identify potential substitution effects during different time periods (see Tab. 5). The results suggest a negative correlation rate for *amount spent*¹⁴ between pre-packaged and stall-served fish during the first lockdown. This phenomenon is probably due, at least in part, to the exposure of the drive during the first lockdown. For all other periods, the correlation is either positive or non-significant. Thus, there are good reasons to believe consumers have substituted their consumption¹⁵ of fresh stall-served fish with fresh pre-packaged fish during the first lockdown. This substitution effect is unlikely to have occurred between distribution channels, as an increase in *market penetration* is observed for pre-packaged fresh fish concurrently in all *generalised distribution channels*. It is important to point out that, this specific substitution effect is also observed for shellfish (5.8% of market shares in value for 2020) and pre-cooked shrimps (2.8% of market shares in value

for 2020). While a high level of consumption for pre-packaged pre-cooked shrimps has been maintained after the first lockdown, pre-packaged fresh shellfish was a one-time phenomenon triggered by the first lockdown. Fresh fish/shellfish species, origin, and quality may often differ depending on the type of packaging. In contrast, pre-packaged and stall-served pre-cooked shrimps are virtually identical. Additionally, pre-packaged pre-cooked shrimps are also significantly more expensive per kg, but slightly greater in terms of the *amount spent per purchasing act*.

In regard to the evolution of the consumption of long shelf life FAPs (frozen and canned products), the panic-buying/stockpiling phenomenon mentioned in the literature also applies to FAPs (Brizi and Biraglia, 2021; Jafri et al., 2021; Lehberger et al., 2021; Nicola et al., 2020). The considerable increase in *market penetration* observed suggests unaccustomed new canned FAPs consumers. These consumers may have not multiplied the *quantities per purchasing act*, but most likely increased their purchasing frequency with the intention of storage (see Tab. 6). It seems that *proximity shops* responded to the concerns and constraints generated by the pandemic during the first lockdown¹⁶. These distribution channels were able to adapt rapidly to great demand from consumers. The use of *proximity shops* for long shelf life FAPs purchases gradually faded away after the first lockdown, whereas it seems to have gained momentum for *online distribution channels*.

The potential substitution effect between fresh and frozen fish is also specific to the first lockdown. Frozen fish share numerous characteristics with fresh fish. The longer shelf life of frozen fish allows for greater flexibility in transport and storage. Consequently, frozen fish are on average cheaper and

¹¹ Stall-served fresh FAPs.

¹² Probably due to an large reduction in supply.

¹³ In volume and value.

¹⁴ Not significant for *quantities purchased*.

¹⁵ At least in value.

¹⁶ Leisure moving restriction to 1 km, limited interaction, etc.

Table 4. Home consumption of fresh fish during lockdowns per distribution channel and selling mode in France.

	Stall-served Fresh Fish		Pre-packaged Fresh Fish	
	First lockdown % Rate of change	Second lockdown % Rate of change	First lockdown % Rate of change	Second lockdown % Rate of change
<u>Amount spent</u>				
Total France	-16.58**	+2.87	+44.17***	+37.78***
Generalised Dist. Channels	-19.67**	-6.7	+47.89***	+39.82***
<i>Incl. Hypermarkets</i>	-19.73**	-0.78	+23.8***	+27.28***
<i>Incl. Supermarkets</i>	-21.81**	-17.01**	+82.82***	+20.64
<i>Incl. Discounters</i>			+67.77***	+83.26***
Specialised Dist. Channels	-8.2	+26.62***		
<u>Quantities purchased</u>				
Total France	-21.09***	+4.2	+41.25***	+40.54***
Generalised Dist. Channels	-22.72***	-4.26	+43.75***	+42.7***
<i>Incl. Hypermarkets</i>	-22.12***	+1.46	+18.9**	+25.81**
<i>Incl. Supermarkets</i>	-26.59***	-14.49	+82.82***	+28.51
<i>Incl. Discounters</i>			+70.39***	+92.66***
Specialised Dist. Channels	-15.16*	+32.8***		
<u>Average Prices</u>				
Total France	+5.89***	-1.11	+2.17*	-2.1
Generalised Dist. Channels	+4.04**	-2.36	+2.96**	-2.08
<i>Incl. Hypermarkets</i>	+3.22*	-2.23	+4.1**	+0.91
<i>Incl. Supermarkets</i>	+6.69**	-2.26	+0.02	-6.09***
<i>Incl. Discounters</i>			-1.91	-5.07*
Specialised Dist. Channels	+8.04	-4.45		
<u>Market penetration</u>				
Total France	-21.51***	-5.28	+27.37***	+31.57***
Generalised Dist. Channels	-22.01***	-10.22*	+29.87***	+31.1***
<i>Incl. Hypermarkets</i>	-21.77***	-6.06	+9.7*	+18.43*
<i>Incl. Supermarkets</i>	-25.97***	-19.57**	+62.36***	+8.49
<i>Incl. Discounters</i>			+45.66***	+69.04***
Specialised Dist. Channels	-19.2**	+14.13		
<u>Amount spent per purchasing act</u>				
Total France	+15.65***	+10.84	+12.42***	+3.83
<u>Quantities purchased per purch. act</u>				
Total France	+7.23**	+10.82**	+8.06***	+4.57**

Student's *t*-test/Welch's *t*-test, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Comparison between March, April and May 2017–2019 (9 observations) and 2020 (3 observations) for the first lockdown.

Comparison between November and December 2017–2019 (6 observations) and 2020 (2 observations) for the second lockdown.

Monthly data extracted on 27/06/21, source: COPECO, based on FranceAgriMer-Kantar data.

purchasable in many distribution channels. Once again, correlation tests are run between those two products' consumption¹⁷ over different time periods (see Tab. 5). Results suggest a negative correlation rate for *quantities purchased*¹⁸ between fresh and frozen fish during the first lockdown whereas, for all other periods, the correlation is positive or non-significant. Consumers may have substituted their consumption¹⁹ of fresh fish with frozen fish during the first lockdown.

Finally, correlation tests have been performed between canned fish and fresh fish consumption (see Tab. 5). It seems there is no significant substitution effect between fresh fish and canned fish during the first lockdown. On the contrary, the evolution of the *amount spent* on fresh and canned fish seems to be strongly positively correlated during the second lockdown. Note that the same phenomenon can also be observed between fresh and frozen fish. This may indicate a brief complementary effect in terms of *amount spent* during the second lockdown.

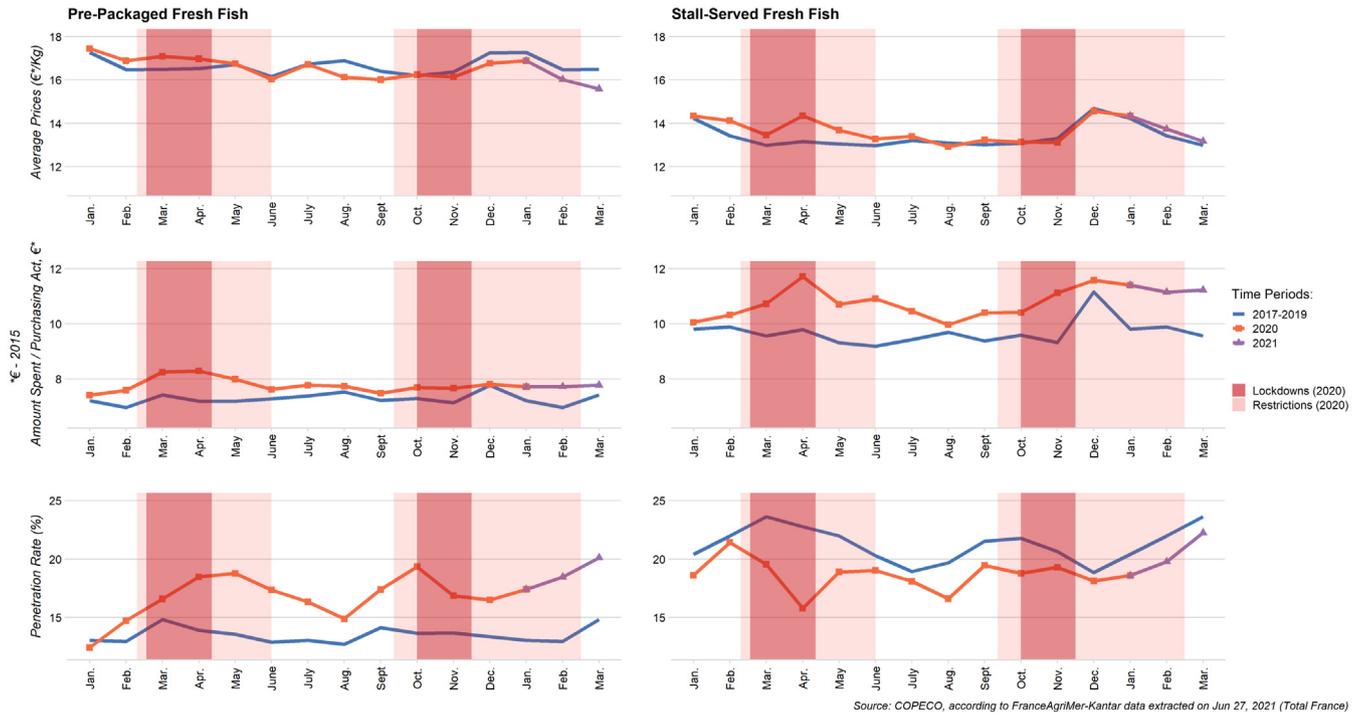
3.2 Annual results of fresh FAPs during the restriction periods

A 5.5% significant increase, in general, is observed for the at-home *quantities purchased* of FAPs (including fresh,

¹⁷ In volume and value.

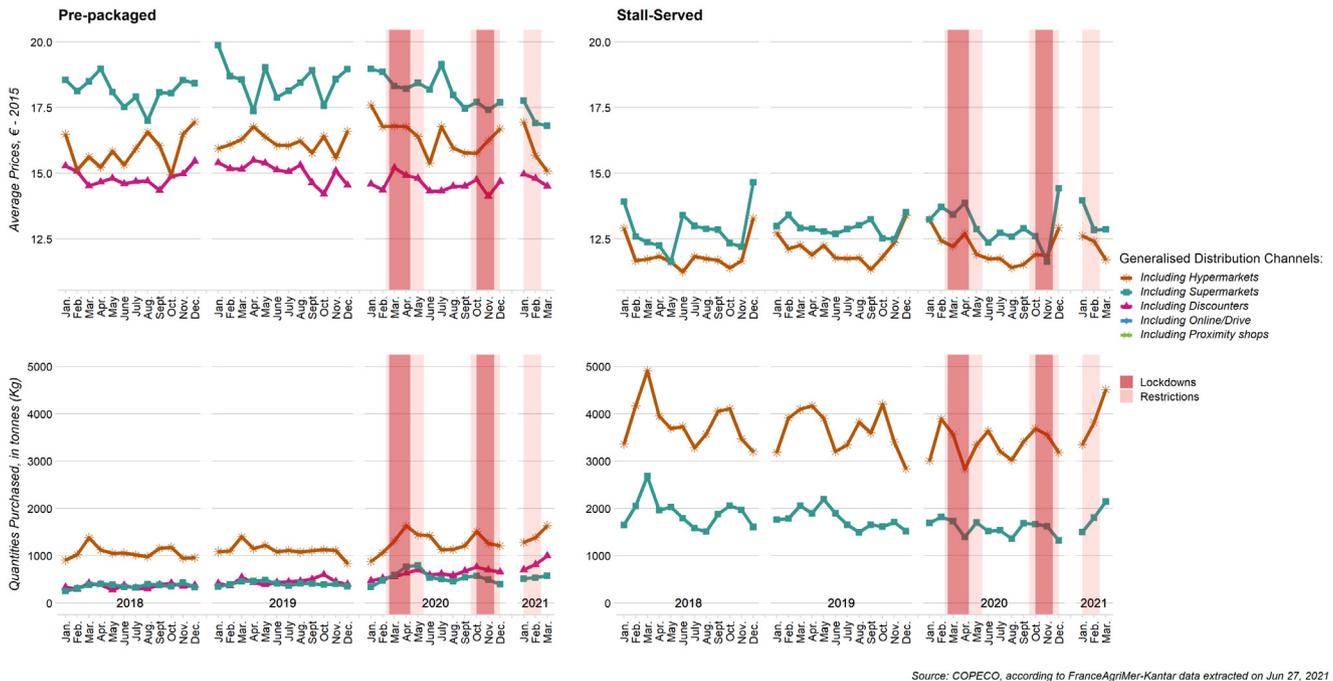
¹⁸ Not significant for *amount spent*.

¹⁹ At least in volume.



Source: COPECO, according to FranceAgriMer-Kantar data extracted on Jun 27, 2021 (Total France)

Fig. 2. Evolution of home consumption variables by selling mode for fresh fish.



Source: COPECO, according to FranceAgriMer-Kantar data extracted on Jun 27, 2021

Fig. 3. Evolution of home consumption within Generalised Distribution Channels by selling mode for fresh fish.

canned, smoked, frozen, delicatessen products, etc.). Despite higher annual expenditure in 2020, the increase in the *amount spent* on FAPs between all months in 2020 and the months from 2017 to 2019 is not significant. This is probably due to a large variance contained in the months of the first lockdown. Additionally, there are no major changes in the at-home

consumption structure²⁰ for the different FAPs categories (see Fig. 4). As there is no significant change in values or volumes consumed at home in 2020 for fresh shellfish, the next results focus on the sole segment of fresh fish.

²⁰Ranks and market shares.

Table 5. Correlation tests between different fishery and aquaculture products for home consumption in France.

	Covid-19 time periods			Benchmark time periods		
	2020	First lockdown ¹	Second lockdown ¹	2017–2019	March–May 2017–2019 ¹	Nov.–Dec. 2017–2019 ¹
Pre-packaged and Stall-Served fresh fish						
<u>Amount spent (coefficients)</u>						
Total France	+0.06	−0.85*	+0.18	+0.38**	+0.39	−0.06
<u>Quantities purchased (coefficients)</u>						
Total France	+0.18	−0.74	+0.59	+0.55***	+0.45*	+0.5*
Frozen fish and fresh fish						
<u>Amount spent (coefficients)</u>						
Total France	+0.39	−0.75	+0.97**	+0.41**	+0.63**	+0.04
<u>Quantities purchased (coefficients)</u>						
Total France	+0.19	−0.88**	+0.74	+0.32*	+0.63**	+0.18
Canned fish and fresh fish						
<u>Amount spent (coefficients)</u>						
Total France	+0.06	−0.35	+0.99***	−0.13	−0.47*	+0.47
<u>Quantities purchased (coefficients)</u>						
Total France	+0.06	−0.25	+0.81	+0.08	−0.37	+0.52*
Number of observations	12	5	4	36	15	12

Pearson correlation test, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

¹ For these time periods, previous and following months are included in the correlation coefficient as standard values. Monthly data extracted on 27/06/21, source: COPECO, based on FranceAgriMer-Kantar data.

If all fresh species are not impacted by the Covid-19 crisis uniformly, fresh fish remains the most consumed category in France for the year 2020 (see Fig. 4). In comparison with 2017–2019, the *amount spent* on fresh fish for at-home consumption increased by 5.6% for 2020 in conjunction with an increase in *average prices* by 3%. Despite a 7% decrease in at-home *quantities purchased* during the first lockdown, there is no significant change in at-home *quantities purchased* on average for 2020 compared to 2017–2019 (see Tab. 7). But looking at some specific species may nuance those results.

Salmon is one of the most consumed species in France, and yet it depends almost exclusively on imports. According to COMEXT data (see Fig. 5), imports of fresh/chilled salmon are on average much higher throughout 2020. This trend appears to be gaining momentum in early 2021. Fresh salmon consumption has increased significantly both in terms of volume (+34.2%) and value (+27.7%) in comparison with 2017–2019 (See Tab. 8). This trend appears to continue into 2021. In 2020, it represents 31%²¹ of all fresh fish consumed, all distribution channels included. Prices have remained relatively stable in 2020 with a downward trend. *Quantities purchased* and *amount spent per purchasing acts* remained similar in 2020. Interestingly, salmon still represents large market shares in *Specialised distribution channels* (including *fishmonger shops, markets/fairs, and fresh supermarkets*) in 2020 (see Fig. 6).

For fresh cod, the consumption heavily depends on imports, although this species can be landed by French fishing vessels. The relation between prices and *quantities purchased*

suggest a strong consumer elasticity for this product: when it is cheap and therefore abundant, its consumption increases strongly. In France, it is the most consumed fresh fish after salmon, however, its consumption has been declining. In 2020, its *quantities purchased* significantly dropped by 19.6% compared to 2017–2019. However, market shares²² in *Specialised distribution channels* has increased in 2020 (see Fig. 6).

France is a large trout producer, and since 2017, trout consumption has been increasing. In 2020, the *amount spent* on fresh trout increased by 13.8% compared to 2017–2019. *Average prices* have increased significantly during both lockdowns. However, fresh trout represents less than 5% in terms of market shares.²³ Moreover, fresh trout is not enough represented in the panel²⁴ in order to have more detailed information on distribution channels. When looking at COMEXT data, it is striking to observe that fresh trout import levels in 2020 are far superior to 2017–2019 (see Fig. 5). This large increase is possibly intended for the transformation industry²⁵. In spite of being generally associated with French production, we cannot exclude that a positive quantity of fresh trout consumed at-home, actually comes from foreign countries.

3.3 Principal component analysis

In FAPs consumption reports and studies, categorising according to the species concerned, and the packaging method is the conventional approach. We propose to reason in terms of

²² In value.

²³ In value.

²⁴ *Market penetration* close to 2%.

²⁵ Smoked trout.

²¹ In value.

Table 6. Home consumption of long-shelf life fishery and aquaculture products during lockdowns per distribution channel in France.

	Canned Fish		Frozen Fish	
	First lockdown % Rate of change	Second lockdown % Rate of change	First lockdown % Rate of change	Second lockdown % Rate of change
<u>Amount spent</u>				
Total France	+22.47***	+12.08	+28.34	+7.58
Generalised Dist. Channels	+22.41***	+11.02	+28.44	+8.31
<i>Incl. Proximity Shops</i>	+67.29***	+7.52		
<i>Incl. Online Dist. Channels</i>	+84.39***	+68.09***		
Specialised Dist. Channels	+24.81**	+45.61*	+28.12**	+6.09
<u>Quantities purchased</u>				
Total France	+16.3***	+8.27	+23.31	+7.46
Generalised Dist. Channels	+15.89***	+6.71	+23.48	+8.85
<i>Incl. Proximity Shops</i>	+60.74***	+7.61		
<i>Incl. Online Dist. Channels</i>	+76.36***	+62.3***		
Specialised Dist. Channels	+36.69***	+72.86	+22.62**	+2.03
<u>Average Prices</u>				
Total France	+5.26***	+3.55	+4.12**	+0.08
Generalised Dist. Channels	+5.59***	+4.09	+4**	-0.54
<i>Incl. Proximity Shops</i>	+4.31*	-0.09		
<i>Incl. Online Dist. Channels</i>	+6.6*	+3.75		
Specialised Dist. Channels	-9.42	-15.27***	+4.81	+4.35
<u>Market penetration</u>				
Total France	+12.1**	+3.16	+18.03	+5.78
Generalised Dist. Channels	+12.01**	+2.34	+17.43	+6.17
<i>Incl. Proximity Shops</i>	+47.33***	+6.06		
<i>Incl. Online Dist. Channels</i>	+90.95***	+56.56***		
Specialised Dist. Channels	+28.49**	+48	+23.99**	+3.87
<u>Amount spent per purchasing act</u>				
Total France	+6.12**	+10.2**	+6.97***	+2.19
<u>Quantities purchased per purch. act</u>				
Total France	-0.97	+4.84	+0.9	+0.56

Student's *t*-test/Welch's *t*-test, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Comparison between March, April and May 2017–2019 (9 observations) and 2020 (3 observations) for the first lockdown.

Comparison between November and December 2017–2019 (6 observations) and 2020 (2 observations) for the second lockdown.

Monthly data extracted on 27/06/21, source: COPECO, based on FranceAgriMer-Kantar data.

purchasing behaviour, and to group FAPs according to their similarities in terms of home consumption variables (see Tab. 2). Using Principal Component Analysis (PCA), we will monitor the evolution of these clusters between 2017–2019 and 2020. Note that clusters are not constructed in an absolute way, but according to the consumption variables of each product in relation to the other products. In other words, cluster construction depends on the sample considered (products and variables selected) and its structure (the link between products). Nonetheless, PCA results can indicate whether the products were consumed in a relatively similar way between 2017–2019 (see Fig. 7), and 2020 (see Fig. 8).

In regard to other products considered, it seems that consumers have not changed the way they consume fresh shellfish (oysters, mussels, and scallops). These products are still characterised by large *quantities purchased per purchasing act*, consumption outside *generalised distribution channels* and low *average prices* (see Tabs. 9 and 10). Note that the presence of the shell in those products causes an artificial reduction in prices compared to other products.

It is therefore hardly surprising that all shellfish with shells were grouped together in the same cluster.

The cluster composed of smoked salmon and canned tuna (Must-have products) did not change either. These products are very different from the others in several dimensions. They share strong seasonality, high *number of purchasing act* and a high *repurchase rates*.

Another group is characterised by strong seasonalities, high *repurchase rate* and large numbers of *number of purchasing act*. This cluster includes products of 'general commodity' or daily products such as surimi, canned mackerel and pilchards, fresh salmon and cod, pre-cooked shrimps, and smoked trout. Obviously, these products do not have the same seasonalities. For example, canned mackerel and sardines are more widely consumed in summer, whereas smoked trout and pre-cooked shrimps are largely consumed in December. Pre-cooked breaded fish has changed from being an expensive and little consumed product to a 'seasonal' mass consumption product. The closure of canteens and the need to cook at home have most likely caused these changes in the consumption of pre-cooked

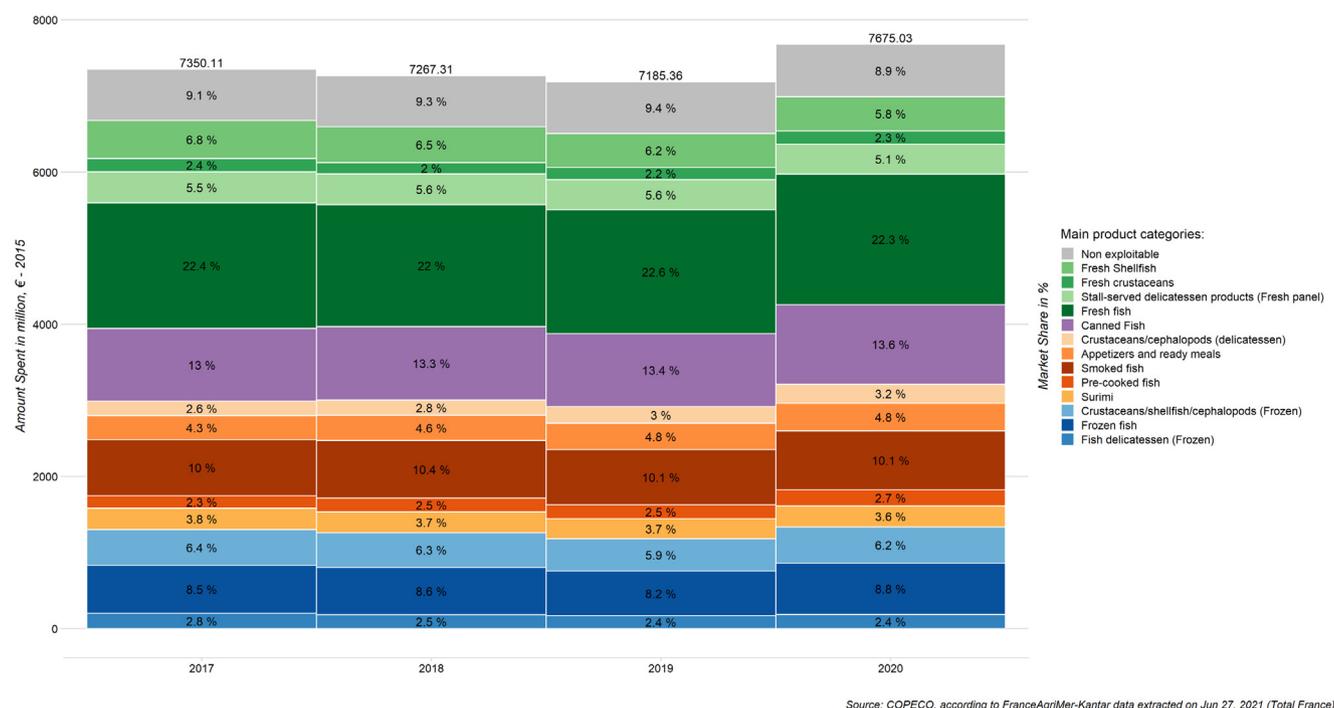


Fig. 4. Market shares for home consumption by category of Fishery and Aquaculture Products in France.

breaded fish. It should be noted that for the beginning of 2021, its consumption is unprecedented, and *discounters* represent a growing market share for this product.

Interestingly, besides fresh salmon and cod, all other fresh fish were characterised differently in 2020. The increase in *average prices* as well as in the *number of purchasing act* may be a cause. As those products are poorly consumed, relatively small changes in the *number of purchasing act* represents large variation rates and thus may affect their clustering. For fresh sardines, mackerel, and trout²⁶, it seems that the increasing consumption in *Specialised distribution channels* explains their change in groups. Shorter distribution channels for at-home consumption may have been more considered for those products, however, at the French scale, their market shares remain very negligible.

Changes were also highlighted by the PCA concerning frozen cod, salmon, and tuna. The increase in *average prices* and in the *number of purchasing act* affected the clustering. These changes observed for frozen fish are not surprising given the stockpiling behaviour observed during the first lockdown. Interestingly, while canned fish was also subjected to the same effect, the PCA does not categorises those products differently from one period to another.

4 Conclusion

FAPs at home consumption in France still remain poorly linked to the primary domestic FAPs supply, despite the Covid-19 crisis and its effects on import restrictions and available surpluses. It seems that salmon and cod are still widely

favoured by at-home French consumers of fresh FAP while their French production is virtually non-existent. Fresh salmon consumption is widening the gap over the fresh cod and other fresh fish, with an increase of *purchased quantities* of 34.2% in 2020 compared to 2017–2019. Granting a relatively low level of consumption, fresh trout is still gaining an increasingly large part of consumers' attention. The abundant supply of fresh salmon initially intended for other markets²⁷, has permitted to consolidate the dominant position of this species in the French market. Fresh shellfish did not change significantly in 2020 regardless of an unprecedented drop in their at-home consumption during the first lockdown. This may illustrate the resilience of consumption for this type of product during a macroeconomic crisis which was *a priori* only a temporary shock.

The already-existing trend of purchasing pre-packaged fresh fish has been greatly amplified by the pandemic and is likely to become a long-term trend. This selling mode, probably initiated by *generalised distribution channels*, has been followed by consumers to the detriment of stalled-served fresh fish during the first lockdown. Although its expensive price per Kg, pre-packaged fresh fish is paradoxically perceived as cheap. It is also perceived as more hygienic and convenient for consumers, as it makes the purchasing act quicker and safer. Likewise, its availability in numerous sale points not to mention the presence of increasingly important information for the food consumer²⁸ can largely explain the popularity of this trend. Despite its relatively low market share, the *online distribution channels*

²⁶ Species with a relatively large share of French production.

²⁷ Private catering or Non-EU markets.

²⁸ Use-by date, origin, label, fishing method, etc.

Table 7. Annual evolution of home consumption in 2020 for fresh fish compared to 2017–2019 in France.

	2020 % Rate of change for fresh fish				
	Total	Stall-served Total	Sliced	Pre-packaged Total	Sliced
<u>Amount spent</u>					
Total France	+5.56*	-5.76*	-9.4**	+35.69***	+35.63***
Generalised Dist. Channels	+4.08	-10.86***	-13.54***	+37.79***	+37.63***
<i>Incl. Hypermarkets</i>	-1.46**	-9.24***	-11.58***	+18.9***	+18.85***
<i>Incl. Supermarkets</i>	-1.73	-15.34***	-17.69***	+47.89***	+46.62***
<i>Incl. Discounters</i>	+64.44***			+65.04***	+62.88***
Specialised Dist. Channels	+10.38***	+7.79*	+3.92		
<u>Quantities purchased</u>					
Total France	+2.3	-7.82**	-12.62***	+35.92***	+36.26***
Generalised Dist. Channels	+0.72	-11.33***	-15.46***	+37.1***	+37.33***
<i>Incl. Hypermarkets</i>	-3.85	-9.79**	-13.69***	+16.78**	+16.69**
<i>Incl. Supermarkets</i>	-5.62	-16.15***	-19.63***	+49.23***	+49.32***
<i>Incl. Discounters</i>	+69.42***			+70.25***	+68.39***
Specialised Dist. Channels	+8.68	+4.8	+0.83		
<u>Average Prices</u>					
Total France	+3.07**	+2.1	+3.36**	-0.16	-0.45
Generalised Dist. Channels	+3.16**	+0.37	+1.89	+0.46	+0.17
<i>Incl. Hypermarkets</i>	+2.36*	+0.45	+2.16	+1.92	+1.91
<i>Incl. Supermarkets</i>	+3.77***	+0.74	+1.79	-0.94	-1.83
<i>Incl. Discounters</i>	-3.46***			-3.54***	-3.71***
Specialised Dist. Channels	+1.67	+3*	+3.16**		
<u>Market penetration</u>					
Total France	+1.71	-11.67***	-12.84***	+26.33***	+25.98***
Generalised Dist. Channels	+1.92	-13.65***	-14.66***	+27.54***	+27.3***
<i>Incl. Hypermarkets</i>	-4.42**	-12.11***	-13.06***	+10.49***	+9.51***
<i>Incl. Supermarkets</i>	-4.31	-18.52***	-19.69***	+34.14***	+33.61***
<i>Incl. Discounters</i>	+52.67***			+52.9***	+52.46***
Specialised Dist. Channels	+3.21	-2.92	-2.83		
<u>Amount spent per purchasing act</u>					
Total France	+6.47***	+10.55***	+9.39***	+6.51***	+6.84***
<u>Quantities purchased per purch. act</u>					
Total France	+1.45	+6.37***	+3.9***	+4.77***	+5.42***

Student's *t*-test/Welch's *t*-test, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Comparison between the months of 2017–2019 (36 observations) and 2020 (12 observations).

Monthly data extracted on 27/06/21, source: COPECO, based on FranceAgriMer-Kantar data.

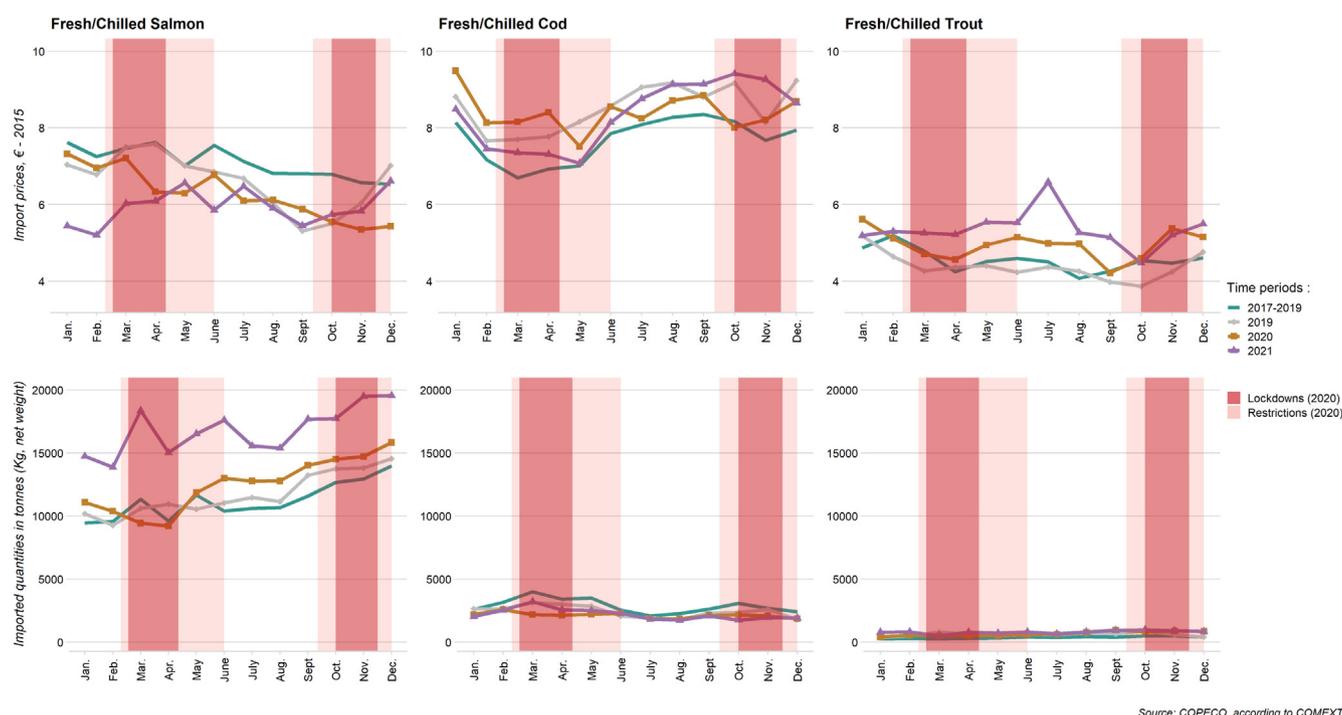
experienced a major increase for fresh fish in 2020. Attracted by the abundant and cheap supply of pre-packaged fresh fish, more and more households favoured *discounters* for their home consumption. The new *discounters*' strategy, based on the 'soft discount' approach, has capitalised on the real or perceived loss of purchasing power of French households during the pandemic to attract more FAPs consumers.

The unusual increase of long shelf life FAPs consumption during the first lockdown is a phenomenon materialising through multiple distribution channels. *Proximity shops* were able to adapt to the very high demand from consumers, and to the constraints generated by the pandemic during the first lockdown. A little time after the first lockdown, the use of *proximity shops* for long shelf life FAPs appears to be returning to an initial level, whereas the use of *online distribution channels* seems to persist after the first and the second lockdown.

Nonetheless, stall-served fresh fish consumption in *Specialised distribution channels*²⁹, increased significantly during the second lockdown and therefore in 2020. In comparison to 2017–2019, the **amount spent** increased by 10.4% and its market share in value now lies around 25%. Regardless of the pre-packaged trend, the valuation by consumers of these distribution channels is probably a new phenomenon, contributing to more sustainability. However, these distribution channels remain dominated by imported species such as salmon and cod.

Given the context and the magnitude of the crisis, one may have expected much greater changes in at-home French consumption. According to the data, the pandemic has likely triggered existing trends rather than questioned deeply rooted unsustainable trends. This gives us further evidence of the

²⁹ Open-air market, *fishmongers*, etc.



Source: COPECO, according to COMEXT

Fig. 5. Evolution of imported prices and quantities for fresh/chilled salmon, cod and trout in France.

Table 8. Annual evolution in 2020 for home consumption of fresh fishery and aquaculture products compared to 2017–2019 in France.

	2020 % Rate of change			
	Salmon	Cod	Trout	Shellfish
<u>Amount spent</u>				
Total France	+27.77***	-10.73	+13.85***	-4.8
<u>Quantities purchased</u>				
Total France	+34.24***	-19.62**	+8.58	-6.89
<u>Average prices</u>				
Total France	-5.19**	+10.42***	+4.67**	+2.75
<u>Market penetration</u>				
Total France	+27.56***	-13.1**	+5.97	-4.33

Student's *t*-test/Welch's *t*-test, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
 Comparison between the months of 2017–2019 (36 observations) and 2020 (12 observations).
 Monthly data extracted on 27/06/21, source: COPECO, based on FranceAgriMer-Kantar data.

resilience of the supply chain and the inertia of consumer habits facing exogenous shocks.

5 Discussion

It is reasonable to assume that consumers' willingness to shift from unsustainable habits can lead to major transformation (Grunert, 2011). It appears that despite good faith and will, consumers are prey to confusion and doubts induced not only by the crisis context but also by marketing techniques and general lack of information. Indeed, when French consumers are asked about the origin of cod, only 23% consider it as more

of an imported species, however, for salmon, this number stands at 60% in 2020 (Herve and Marchenay, 2020).

The distinction between a change in consumer behaviour and a change in FAPs supply distribution channels appears to be difficult and needs to be treated carefully. This question, widely discussed by economists, relates to the interdependence of supply and demand. According to Ugaglia et al. (2021) the answer could be found on the supply side and its institutional structures. According to (Villasante et al., 2021), the pandemic led to abrupt shifts in demand and supply in the Galician seafood sectors. It is therefore hardly surprising to observe the same phenomenon in France. We believe that both effects are present and have contributed to the changes observed in the

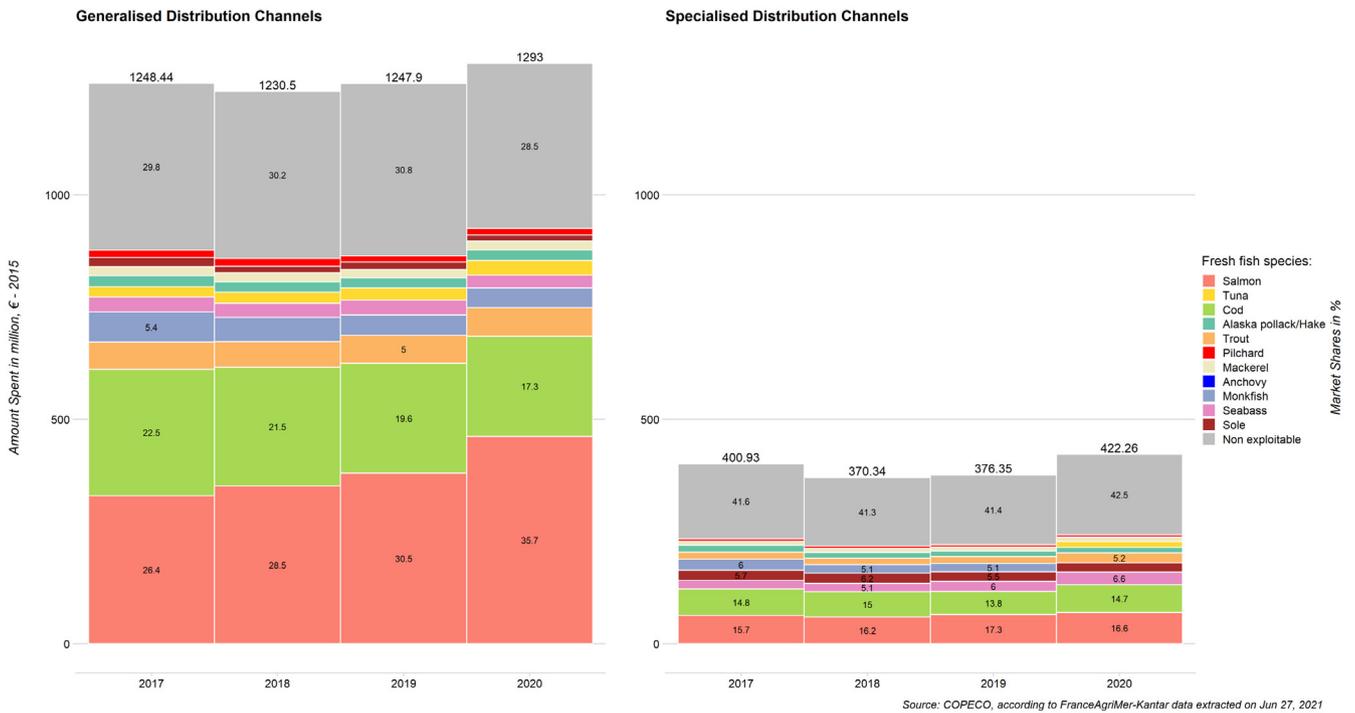


Fig. 6. Market shares per fresh fish species available between Distribution Channels for home consumption in France.

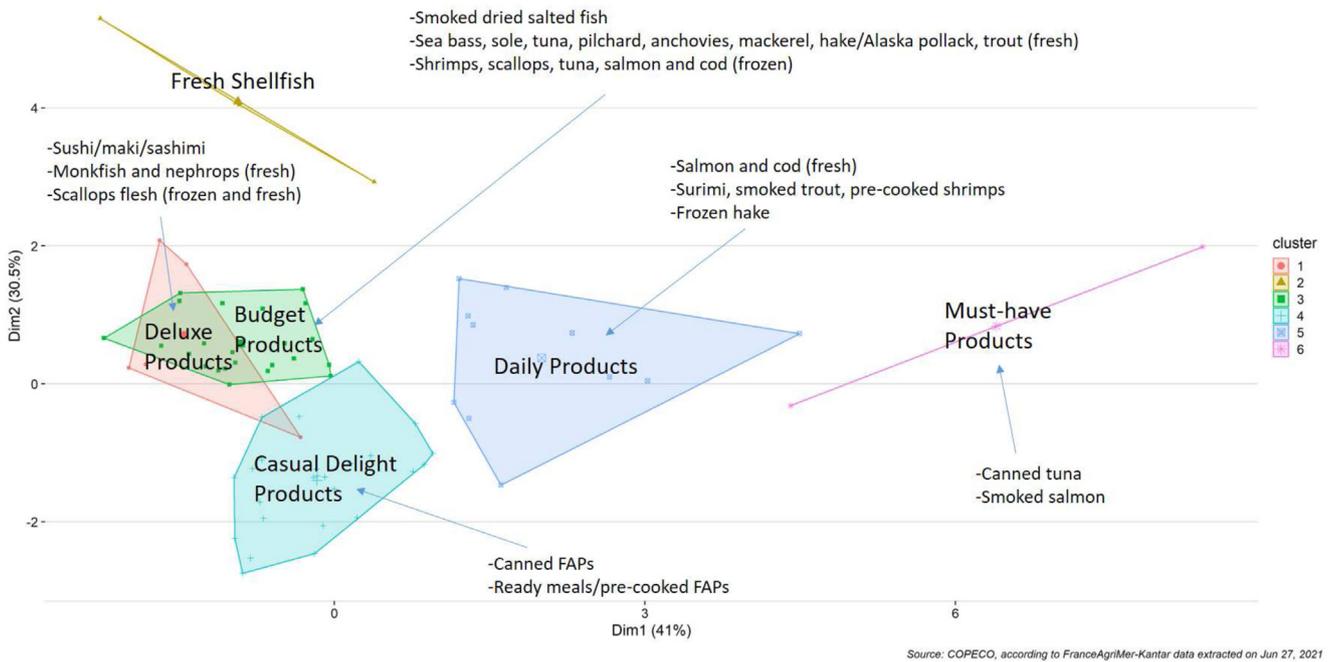


Fig. 7. Use of Principal Component Analysis to categorise products by home consumption purchasing variables for 2017–2019 in France.

database. The increase in the consumption of pre-packaged food is not a new phenomenon³⁰. In the past, *generalised distribution channels* have probably tried to increase their supply of pre-packaged food without being followed by consumers. They also most certainly have access to the Kantar

panel together with sale points checkout data. It is reasonable to assume that many distribution channels adjust their strategies in the short term according to their observations on demand³¹. The same reasoning can be applied to the case of fresh salmon, which share many similarities. Given the scarcity

³⁰ It is very interesting to note the similarities with meat products.

³¹ During the Covid-19 crisis or not.

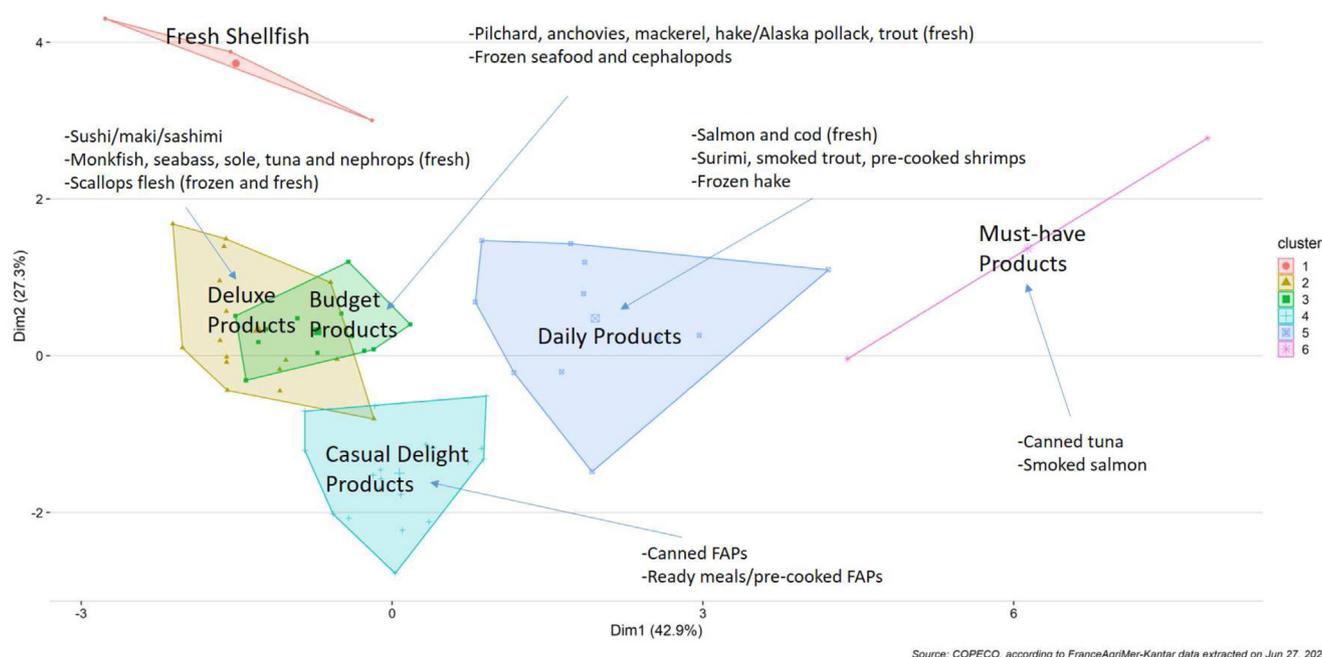


Fig. 8. Use of Principal Component Analysis to categorise products by home consumption purchasing variables for 2020 in France.

Table 9. Description of each cluster by quantitative variables for the principal component analysis for 2017–2019.

Variables (PCA 2017–2019)	<i>v</i> test	Mean in category	Overall mean	SD in category	Overall SD	<i>p</i> value
Cluster 1 (Deluxe Products)						
Amount spent per purchasing act	5.34	0.14	0.63	0.17	0.31	9.35E–02
Average price	2.62	0.25	1.58	0.70	0.78	8.68E+03
Cluster 2 (Fresh Shellfish)						
Quantities purchased per purchasing act	6.86	1.85	0.47	0.28	0.35	7.01E–06
Amount spent per purchasing act	2.35	10.47	6.27	3.00	3.13	1.85E+04
Ratio sold in Generalised Dist. Channels	–2.26	0.61	0.82	0.14	0.17	2.40E+04
Average price	–2.33	5.46	15.77	1.34	7.77	1.96E+04
Cluster 3 (Budget Products)						
Repurchase rate	–2.07	3.92	4.42	0.83	1.39	3.80E+04
Number of purchasing act (in million)	–2.23	0.68	1.62	0.46	2.47	2.56E+04
Ratio sold in Generalised Dist. Channels	–5.56	0.07	0.08	0.01	0.02	2.74E–02
Cluster 4 (Casual Delight Products)						
Ratio sold in Generalised Dist. Channels	5.34	0.10	0.08	0.00	0.02	9.31E–02
Variance of market penetration	–2.07	0.25	1.23	0.41	2.94	3.88E+04
Number of purchasing act (in million)	–2.55	0.61	1.62	0.57	2.47	1.08E+04
Repurchase rate	–2.99	3.75	4.42	0.97	1.39	2.81E+03
Quantities purchased per purchasing act	–3.83	0.03	0.05	0.01	0.04	1.26E+02
Amount spent per purchasing act	–4.39	0.41	0.63	0.13	0.31	1.14E+01
Cluster 5 (Daily Products)						
Repurchase rate	5.15	6.41	4.42	0.53	1.39	2.60E–01
Number of purchasing act (in million)	4.46	4.68	1.62	1.72	2.47	8.27E+00
Variance of market penetration	2.44	3.23	1.23	1.40	2.94	1.47E+04
Cluster 6 (Must-have Products)						
Variance of market penetration	7.22	16.11	1.23	3.72	2.94	5.06E–07
Number of purchasing act (in million)	5.62	11.35	1.62	3.72	2.47	1.96E–02
Repurchase rate	3.51	7.84	4.42	0.70	1.39	4.49E+02

PCA carried out on 69 usable products over the years 2017 to 2019.

Annual data extracted on 27/06/21, source: COPECO, based on FranceAgriMer-Kantar data.

Table 10. Description of each cluster by quantitative variables for the Principal Component Analysis in 2020.

Variables (PCA 2020)	ν test	Mean in category	Overall mean	sd in category	Overall sd	p value
Cluster 1 (Fresh Shellfish)						
Quantities purchased per purchasing act	6.64	1.78	0.49	0.16	0.34	3.05E-05
Amount spent per purchasing act	2.10	10.29	6.51	2.45	3.18	3.62E+04
Ratio sold in Generalised Dist. Channels	-2.03	0.60	0.80	0.12	0.17	4.21E+04
Average price	-2.38	5.47	15.11	1.11	7.12	1.71E+04
Cluster 2 (Deluxe Products)						
Amount spent per purchasing act	5.60	1.02	0.65	0.24	0.32	2.16E-02
Average price	2.93	1.95	1.51	0.47	0.71	3.39E+03
Number of purchasing act (in million)	-2.06	0.67	1.83	0.48	2.69	3.97E+04
Repurchase rate	-2.25	4.04	4.66	0.79	1.32	2.42E+04
Ratio sold in Generalised Dist. Channels	-4.03	0.07	0.08	0.02	0.02	5.66E+01
Cluster 3 (Budget Products)						
Average price	-3.04	0.94	0.15	0.25	0.71	0.002367
Cluster 4 (Casual Delight Products)						
Ratio sold in Generalised Dist. Channels	4.57	0.10	0.08	0.00	0.02	4.85E+00
Number of purchasing act (in million)	-2.11	0.73	1.83	0.62	2.69	3.48E+04
Repurchase rate	-2.18	4.10	4.66	0.74	1.32	2.92E+04
Quantities purchased per purchasing act	-3.76	0.02	0.05	0.01	0.03	1.68E+02
Amount spent per purchasing act	-4.26	0.39	0.65	0.13	0.32	2.05E+01
Cluster 5 (Daily Products)						
Repurchase rate	5.20	6.56	4.66	0.52	1.32	2.05E-01
Number of purchasing act (in million)	4.28	5.02	1.83	1.74	2.69	1.89E+01
Variance of market penetration	2.46	3.47	1.39	1.37	3.06	1.39E+04
Cluster 6 (Must-have Products)						
Variance of market penetration	6.95	16.29	1.39	3.26	3.06	3.75E-06
Number of purchasing act (in million)	5.41	12.04	1.83	4.11	2.69	6.44E-02
Repurchase rate	3.47	7.88	4.66	0.75	1.32	5.30E+02

PCA carried out on 64 usable products for the year 2020.

Annual data extracted on 27/06/21, source: COPECO, based on FranceAgriMer-Kantar data.

of certain food products³², it is also possible that during the first lockdown, the demand adapted more to the supply than in 'normal' times. For a variety of reasons, the price of fresh fish sold in *hypermarkets*' and *supermarkets*' fish stalls increased significantly during the first lockdown, while the price of pre-packaged fish remained relatively stable. However, it is very likely that fish stalls-served fresh fish is perceived (falsely) as more expensive by consumers. Indeed, taking a look at the *amount spent per purchasing act*, fish stalls-served fresh fish is much more expensive (see Fig. 2). One cannot exclude that consumers are looking for a 'cheaper' alternative to stall-served fresh fish during the crisis, independently of the supply strategy of the sale points. Unfortunately, it is not possible with the available data to quantify the magnitude of these two effects, and achieving such results implies many hypotheses along with access to difficultly observable information on both consumers' and suppliers' behaviour.

Similarly to frozen fish, the exceptional increase in consumption of these products at home during the first lockdown can easily be explained by stockpiling behaviour.

This phenomenon has been observed in many countries (FAO, 2012; Richards and Rickard, 2020), including France (FranceAgriMer, 2021b; Kantar, 2020). Once again, our data does not allow the quantification of these two distinct effects.

Additionally, many authors suggest that households shifted toward local/regional channels during the pandemic (FranceAgriMer, 2021b; Francois-Lecompte et al., 2021; Hollandts, 2020; Ugaglia et al., 2021; Villasante et al., 2021) ensuring food security and resilience to potential future macroeconomic shocks (Bassett et al., 2021). In some cases, this phenomenon was viewed as a temporary effect caused by a disruption of the supply chain, where consumers have fallen back on available stocks as their next best alternative (Stoll et al., 2021). In spite of relative growth of *Specialised distribution channels* for fresh fish in 2020, some *generalised distribution channels* have put forward more local products (Pititto et al., 2021). On the other hand, it is possible to buy salmon³³ in *markets/fares* or in fishmonger shops. Thus, making an assessment on the length of a given distribution channel and a given product may be delicate. Which is why

³² Due to the closure of some hyper/supermarket fish stalls, problems of fishing landings, panic buying, etc.

³³ Most likely imported.

some authors speak of ‘zero km food strategies’, between producers and the final consumer (Aldaco et al., 2020).

A fairly simple way to check whether French home consumption is becoming more sustainable would be to explore the evolution of FAPs home consumption labelled with the Marine Stewardship Council (MSC; <https://www.msc.org/uk>) and/or Aquaculture Stewardship Council (ASC; <https://www.asc-aqua.org/>). This could provide very interesting insights, however, this information is not contained in the Kantar dataset. Due to lack of data, sustainable issues related to home consumption are evaluated here solely through an approximation of primary domestic supply. Analysing more appropriate data such as short distribution channels or sustainable certifications may nuance our findings.

The development of *online distribution channels* along with *proximity shops* for pre-packaged fresh fish and frozen fish, the recent renewed interest in consumers for fresh and smoked trout as well as fresh sardines and fresh mackerel in *Specialised distribution channels* should be monitored beyond the Covid-19 crisis. Indeed, weak signals suggest new trends regarding those products in those distribution channels. However, these early-stage trends are not yet enough represented in the dataset to assess with certainty the rise of one or several new trends.

6 Limits

We do not observe any major change towards more sustainable at-home consumption in France. There are two possible explanations: (1) there are no changes; (2) we do not have the tools to catch all these changes at the French level. Nevertheless, we suppose the used methodology will have allowed us to observe major changes, if any; and that only minor changes or changes in their premise would have slipped through our analysis.

As we observe atypical behaviours during the first lockdown on at-home consumption for many FAPS, annual results may be biased by this period of time. Additional time periods would be needed, especially 2021 data, to get a better idea of any persistent trends.

To go beyond these limits, we plan to use data since 2005 in order to carry out a time-series analysis and accumulate more evidence of the long-term evolution of fresh FAPs at-home consumption in France. Furthermore, with exploitable individual data, it would be possible to isolate precisely effects such as substitution effects between products and distribution channels, price effects, socio-demographic effects on at-home consumption, etc.

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