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Consumer Preferences, Ecolabels, and Effects of Negative Environmental Information

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Consumers prefer ecolabeled products. However, little is known about the effects of ecolabels when consumers are simultaneously exposed to negative environmental information about the ecolabeled products. We conducted a stated choice experiment in France with eight types of fish that were either ecolabeled or unlabeled. Four treatments with different types of information concerning potential negative environmental effects of wild fisheries and/or fish farming were used. We found that participants were willing to pay a 4% premium for Marine-Stewardship-Council-labeled wild cod, and a premium of about 11% for Agriculture-Biologique-labeled farmed salmon and farmed cod. However, when participants receive negative environmental information on farmed fish or harvesting wild species, willingness to pay falls by more than the positive effect of ecolabeling. This implies that the ecolabeling organizations need to improve consumers' trust in their labels. Public authorities can also play a more active role in developing trust in ecolabels.

Key words: discrete choice, ecolabels, environmental information, fish, stated preference.

Introduction

Labels that signal the presence or absence of specific attributes is one source of information about food products. Food labels can significantly change the purchasing behavior of consumers (e.g., Caswell & Anders, 2011). Ecolabeling is increasingly used by the seafood industry to meet consumers' concerns about the environmental impacts and sustainability of wild fisheries and aquaculture. Much of the focus on ecolabeling has been on the certification of wild fish types, such as the labeling activities of the Marine Stewardship Council (MSC). However, farmed fish has become increasingly important, and ecolabels for farmed fish are in the process of gaining global influence. Several studies using data from surveys, laboratory experiments, and retail trade find that consumers are willing to pay a premium for ecolabeled fish types (e.g., Jaffry, Pickering, Ghulam, Whitmarsh, & Wattage, 2004; Mauracher, Tempesta, & Vecchiato, 2013; Olesen, Alfnes, Røra, & Kolstad, 2010; Roheim, Asche, & Santos, 2011; Wessells, Johnston, & Donath, 1999).

Other sources of information also influence the preferences for food products as demonstrated in several studies (e.g., Fox, Hayes, & Shogren, 2002; Rousu, Huffman, Shogren, & Tegene, 2004, 2007). Consumers receive information about wild fisheries and aquaculture from newspapers, TV, trade organizations, and nongovernmental organizations. One example is the Eastern Baltic cod that was severely overexploited. This overexploitation was widely covered in the Swedish media, and the World Wildlife Fund (WWF) listed the Eastern Baltic cod on its blacklist and advised consumers against buying it. As a result, many Swedish consumers stopped buying not only Baltic cod but also cod from healthy stocks.

In this study, total effects of labeling and information from other sources are investigated. We include four sets of environmental information and two labels. The labels are the MSC and the organic French Agriculture Biologique (AB) labels. The AB label is the most widely used organic label in France. The environmental information is related to the potential damages to the environment from cod farming, salmon farming, and wild cod fisheries. In the presence of labeling, the effects of these types of information may be complex. First, there are direct effects on the willingness-to-pay (WTP) for the product, at which the information is aimed (e.g., farmed salmon). Since consumers may purchase both ecolabeled and unlabeled varieties of this product, there may be different direct effects for ecolabeled and unlabeled products. Second, there are indirect effects of information on the substitutes of the product, at which the information is aimed. These indirect effects may depend both on the production method of the substitutes (wild versus farmed) and whether they are ecolabeled or unlabeled. For example, let the negative information be about farmed salmon. We can then differentiate between four groups of indirect effects: (i) effects on ecolabeled fish that is produced with the same production technology, such as ecolabeled farmed cod; (ii) effects on ecolabeled fish that is produced with the other production technology, such as ecolabeled wild cod; (iii) effects on unlabeled fish that is produced with the same technology, such as unlabeled farmed cod; and (iv) effects on unlabeled fish that is produced with the other production technology, such as unlabeled wild cod.

To our knowledge, the total effects of negative environmental information and ecolabels on the WTP for various fish types have not been previously investigated. Our objectives are to investigate the direct effects of negative information on the WTP for ecolabeled and unlabeled fish and to investigate the indirect effects of negative information on the WTP for the substitutes to the fish type, at which the information is aimed.

To investigate the effects of negative information, we designed and carried out a stated choice experiment with a focus on the WTP for Norwegian seafood in France. Norway is the second-largest seafood exporter after China, and seafood exports generate about 7% of the Norwegian export value. The total Norwegian seafood export was about $10 billion in 2013. About 70% was from aquaculture (mainly salmon) and 30% from wild fisheries with cod and pelagic species as the most important fish types. France and Russia are the two most important markets for the Norwegian seafood export. In the French market, salmon and cod are the two most important species of fish, and we focus on them.

Ecolabels and Environmental Issues in Seafood Markets

Fishery management policies have focused on developing and enforcing management schemes related to the supply side of the seafood market. To a large extent, such schemes have been ineffective in conserving wild fish stocks (Beddington, Agnew, & Clark, 2007). The Food and Agriculture Organization (FAO) of the United Nations estimated that almost 60% of the world's fish stocks were fully exploited in 2009, and almost 30% were overexploited (FAO, 2011).

The environmental information provided in the experiment was related to: (i) cod farming, (ii) wild cod fisheries, (iii) cod farming and wild cod fisheries, and (iv) salmon farming. The information concerning fish farming focused on escape from breeding cages with associated genetic pollution of wild stocks, problems with parasites, problems with use of chemicals to treat diseases, overexploitation of species used for feed, and pollution of the seabed. The information about wild fisheries focused on depleted stocks and discarding. An English translation of the four information treatments is included in the Appendix.

For consumers, it is difficult to know if a fish stock is depleted, and ecolabeling is a way to convey this information. It may be insufficient to know the species of the fish, and information about where and when the fish was caught may be desirable. One example is Norwegian cod. Cod from the North Sea and the Norwegian coast is believed to be under considerable pressure and has not been granted the MSC label, whereas the cod fishery in the Barents Sea, which is currently generating record landings, does have the MSC label. To further increase the confusion, cod from the Barents Sea, which comes to the shores of Northern Norway during the winter months to spawn, can be caught during this period and MSC labeled.

A number of ecolabeling programs have been introduced following increased consumer concerns about overexploitation of wild fish stocks as well as other issues in seafood production. These issues include (i) safety (e.g., Wessells & Anderson, 1995; Wessells, Kline, & Anderson, 1996), (ii) quality (e.g., Brécard, Hlaimi, Lucas, Perraudeau, & Salladarré, 2009; Salladarré, Guillotreau, Perraudeau, & Monfort, 2010; Verbeke, Vanhonacker, Sioen, Van Camp, & De Henauw, 2007), (iii) environmental effects (e.g., Jaffry et al., 2004; Verbeke et al., 2007), (iv) sustainability (e.g., Sogn-Grundvåg, Larsen, & Young, 2013), and (v) fish welfare (e.g., Aarset et al., 2004; Teisl, Roe, & Hicks, 2002; Verbeke et al., 2007). For more information on ecolabels, see Consumer Reports (n.d.).

There is no French national ecolabeling scheme for wild fish, and several labels are used by retailers. As early as the spring of 2004, Carrefour launched its own ecolabel for wild cod products. Other large retailers and processors of seafood followed with their own private labels (Salladarré et al., 2010). The certification program of the MSC is currently the most widely used and recognized sustainable wild fish labeling scheme in the world, and it is also used in France (Gulbrandsen, 2009; Thrane, Ziegler, & Sonesson, 2009). As of November 2014, 243 fisheries have been certified by the MSC program, and another 102 fisheries were being assessed (Marine Stewardship Council, n.d.). In this study, we use the MSC label for wild fish.

No ecolabeling program for farmed fish has so far gained wide international acceptance. The Aquaculture Stewardship Council (ASC) is the aquaculture counterpart to the MSC. It was founded in 2009 by the WWF

Table 1. The products in the experiment.

Species	Wild or farmed	Ecolabel	Area of origin [a]	Price range [b]
Salmon	Farmed	None	Norway	€1.95 - 5.45
Salmon	Farmed	AB	Norway	€3.45 - 7.95
Cod	Farmed	None	Norway	€2.95 - 6.95
Cod	Farmed	AB	Norway	€4.95 - 10.95
Cod	Wild	None	North Atlantic	€2.95 - 6.95
Cod	Wild	MSC	North Atlantic	€4.95 - 10.95
Monkfish	Wild	None	North Atlantic	€5.45 - 11.45
Pangasius	Farmed	None	Vietnam	€1.45 - 4.95

[a] The area of origin is the origin that is most common for the fish type in the French market. For the AB-labeled cod and salmon, we use the same origin as for the conventional cod and salmon.
[b] Price range for a 300g package. An eight-point price scale was used for each product.

and the Dutch Sustainable Trade Initiative. The ASC aims to provide certification schemes for responsibly farmed fish. As of June 2013, only a few fish farms from six countries were certified, although Marine Harvest, which is the world's biggest producer of salmon, announced in May 2013 that it would seek company-wide ASC certification by 2020. In this study, we use the AB label for farmed fish. The AB label is the most widely used ecolabel for food in France, and it certifies food products with an organic content of at least 95%. Farmed fish can be labeled as organic, whereas wild fish cannot. At the time of the experiment, we were unable to find any certified organic fish in the French market.

The most important success measure for ecolabeling programs is the size of the premium that consumers are willing to pay for the labeled products (Nilsson, Tunçer, & Thidell, 2004; Thøgersen, 2000). Many studies suggest that labeling has a positive effect. Jaffry et al. (2004) used a choice experiment and found that ecolabeled seafood from a sustainably managed fishery had up to a 7% higher probability of being chosen by participants. Roheim et al. (2011) analyzed scanner data of MSC-certified frozen processed Alaskan pollock products and found that UK consumers were willing to pay a 14% premium for the label. Olesen et al. (2010) conducted a non-hypothetical choice experiment and found that the average Norwegian participant was willing to pay a 15% premium for organic salmon. Mauracher et al. (2013) found a significant price premium for organic Mediterranean sea bass. However, all these estimates were obtained by focusing on the effects of one label, and the values may change in a more realistic setting with several labels and additional information.

Experimental Design

The experiment was carried out in the sensory laboratory of l'Institut National de la Recherche Agronomique (INRA) in Dijon in December 2008. Potential participants were randomly drawn from INRA's consumer panel.[1] In the recruitment process, they were asked to answer a short survey on their consumption and purchasing frequencies of fish. Only those who ate fish at home more than once a month and bought fresh fish themselves at least every second month were recruited. Each participant was paid €25 to participate in the experiment.

As shown in Table 1, there were five unlabeled and three ecolabeled fish types included in the experiment. Each fish type was labeled with species, area of origin, and price. Furthermore, the farmed fish types were labeled as such. Monkfish and pangasius were included as an expensive and an inexpensive substitute for cod and salmon. Both fish types were always unlabeled. The price range of the unlabeled fish was based on market prices in Dijon at the time of the experiment. In the market, the prices varied considerably, and the price variation reflects factors such as size, quality, cut, outlet, day, and promotions. The price ranges used in the experi-

1. The consumer panel is a database of participants who volunteer to participate in sensory experiments. The volunteers have been recruited in several ways: random selection of phone numbers in representative districts of all socioeconomic classes of Dijon and the suburbs, advertisements in the local press, and during exhibitions. Dijon is a city with about 150,000 inhabitants and is located 300 km southeast of Paris. The city is representative of France in terms of household disposable income and socio-demographic composition. Fresh fish consumption in Dijon is slightly below the average consumption in France, but representative of the non-coastal regions.

ment covered the minimum and maximum prices found in the market. For the ecolabeled products, the price ranges were set €1.50 - 2.00 above the price ranges of the corresponding unlabeled products.

To reduce the hypothetical nature of the experiment, we used real fish that were professionally packed in 300-gram packages of fish loins. Loins are the best cuts of the fish, which explains the relatively high prices shown in Table 1. No ecolabeled farmed fish types were available in France at the time of the experiment, so unlabeled fish was ecolabeled for use in the experiment. To avoid selling these products to the participants, a stated choice format was selected.

We constructed 112 choice sets that were divided into seven blocks with 16 choice sets in each block. We had 14 sessions and each block was used in two sessions. In each choice set, three products were presented in a Styrofoam box filled with ice, and a none-of-these alternative was included as an additional alternative. To avoid systematic ordering effects, the participants could start at any of the 16 choice sets.[2]

One hundred and sixteen participants had previously taken part in one or more fish experiments, and we refer to them as experienced participants; the remaining 78 participants are referred to as new participants. There were six sessions with new participants and eight sessions with experienced participants. The experienced participants conducted two rounds of choices with an information treatment between the rounds, while the new participants only completed one round of choices with information given before the choices. In two of the sessions with new participants no information was provided, while each of the four information treatments was used in one of the other four sessions with new participants. In the sessions with experienced participants, each information treatment was used in two sessions. The distribution of choice blocks and information treatments across sessions was determined before the experiment. At the time of recruitment, the participants were given a choice between available sessions he or she could participate in, but did not know any details about the choice experiment.

Each of the 78 new participants made 16 choices resulting in a total of 1,248 choices (1,246 useable choices). The 116 experienced participants made 16 choices and then received the information treatment allocated to the session and made the same 16 choices again. This resulted in a total of 3,712 choices (3,709 useable choices).[3]

Econometric Model

A mixed logit model (McFadden & Train, 2000) was used to estimate the model for all the participants. We let p denote price and group the other variables in three vectors of dummy variables. The vector **Fish** includes five dummy variables that correspond to the five fish types—wild cod, farmed cod, farmed salmon, wild monkfish, and farmed pangasius. These dummy variables are coded as 1 if we observe the specified fish type and 0 otherwise. The vector **Ecolabel** includes two dummy variables that are coded as 1 if the fish was labeled with the MSC or the AB label and 0 otherwise. The vector **Information** includes six dummy variables that account for the two direct and the four indirect effects of information. The first variable is coded as 1 if the participant received information aimed at the chosen and unlabeled fish type. The second variable is coded as 1 if the participant received information aimed at the chosen and ecolabeled fish type.[4] The third variable is coded as 1 if the participant received information about a different fish type (e.g., salmon) than the chosen and labeled fish type (e.g., labeled cod), and both fish types were produced by using the same production technology (i.e., farmed). The fourth variable is coded as 1 if the participant received information about a different fish type (e.g., salmon) than the chosen and labeled fish type (e.g., labeled cod), and the two fish types were produced by using different technologies (farmed and wild). The fifth variable is coded as 1 if the participant received information about a different fish type (e.g., salmon) than the chosen and unlabeled fish type (e.g., unlabeled cod), and both fish types were produced by using the same production technology (i.e., farmed). The sixth variable is coded as 1 if the participant received information about a different fish type (e.g., salmon) than the chosen and unlabeled fish type (e.g., unlabeled cod), and the two fish types were produced by using different technologies (farmed and wild).

2. *The choice design with eight products sold at varying prices was constructed by the SAS macro MktEx with zero priors, and the D-efficiency of the total design was 96.52.*

3. *By this procedure, we created between-subject variation among new participants and within-subject variation among experienced participants. However, to obtain a sufficiently large sample size, we pooled data from both groups for estimating the econometric model.*

4. *We did not distinguish between the MSC and the AB label to facilitate estimation of the model.*

Table 2. Mixed logit results and willingness-to-pay estimates.

Attribute	Mixed logit: Coefficient [a]	Mixed logit: Std. deviation [a]	WTP estimate: Mean WTP [a]	WTP estimate: 95% confidence interval
Wild cod	7.34*** (0.28)	3.80*** (0.24)	18.14*** (0.36)	[17.43, 18.86]
Farmed cod	6.66*** (0.28)	4.14*** (0.23)	16.46*** (0.36)	[15.76, 17.16]
Farmed salmon	7.19*** (0.26)	4.29*** (0.17)	17.78*** (0.31)	[17.17, 18.39]
Wild monkfish	8.26*** (0.31)	4.08*** (0.23)	20.44*** (0.41)	[19.63, 21.25]
Farmed pangasius	0.12 (0.40)	5.84*** (0.44)	0.29 (0.98)	[-1.63, 2.22]
MSC label	0.32 (0.17)	1.40*** (0.16)	0.80* (0.42)	[-0.03, 1.62]
AB label	0.74*** (0.11)	0.94*** (0.12)	1.84*** (0.28)	[1.30, 2.24]
Direct-effect unlabeled fish	-0.87*** (0.20)	1.36*** (0.23)	-2.16*** (0.50)	[-3.15, -1.18]
Direct-effect labeled fish	-0.94*** (0.20)	0.94*** (0.12)	-2.32*** (0.50)	[-3.31, -1.33]
Indirect effect on labeled fish produced with the same technology [b]	0.38* (0.21)	1.16*** (0.22)	0.95* (0.51)	[-0.05, 1.95]
Indirect effect on labeled fish produced with different technology [b]	-0.17 (0.19)	1.00*** (0.16)	-0.41 (0.47)	[-1.32, 0.51]
Indirect effect on unlabeled fish produced with the same technology [b]	0.40** (0.16)	1.17*** (0.19)	0.98** (0.40)	[0.20, 1.76]
Indirect effect on unlabeled fish produced with different technology [b]	-0.31** (0.15)	0.94*** (0.17)	-0.77** (0.38)	[-1.53, -0.02]
Price (€ per kg)	-0.40*** (0.01)	0.24*** (0.01)	-	-
Log likelihood function	-3,786.05			
Bayes information criterion	8,584.60			
Akaike information criterion	7,810.10			
McFadden pseudo R^2	0.65			

[a] *The numbers in parentheses are the standard errors. Significance at the 10%, 5%, and 1% level of significance are denoted with *, **, and ***, respectively.*

[b] *The technologies are "wild fisheries" and "aquaculture." For example, when the environmental information concerns farmed salmon, then the indirect effect of the information on ecolabeled wild cod is denoted "indirect effect labeled fish produced with different technology."*

When participant n chooses alternative j in choice situation t, the participant obtains utility U_{njt}:

$$U_{njt} = \alpha_n p_{njt} + \boldsymbol{\beta_n} \textbf{\textit{Fish}}_{\boldsymbol{njt}} + \boldsymbol{\gamma_n} \textbf{\textit{Ecolabel}}_{\boldsymbol{njt}} + \boldsymbol{\delta_n} \textbf{\textit{Information}}_{\boldsymbol{njt}} + \varepsilon_{njt}, \quad (1)$$

where α_n is the individual-specific coefficient for price, $\boldsymbol{\beta_n}$, $\boldsymbol{\gamma_n}$, and $\boldsymbol{\delta_n}$ are individual-specific coefficient vectors, and ε_{njt} is an error term that is assumed to have extreme value distribution and to be independent and identically distributed across observations. All individual specific coefficients are specified to follow normal distribution.

Equation 1 was estimated by maximizing the simulated log likelihood function using NLOGIT 5 (Greene, 2012). We specified 2,000 Halton draws per iteration, used the panel structure of the data and allowed for free correlation among the random coefficients. We estimated the WTP values by calculating the negative ratio between the coefficient of a nonprice variable and the price coefficient. The standard errors of the WTP estimates were estimated by the delta method (e.g., Hole, 2007).[5]

Results and Discussion

The estimated coefficients, the standard deviations of the coefficients, the corresponding WTP estimates, and the standard errors associated with these parameter estimates are presented in Table 2. Furthermore, the 95% confidence intervals of the WTP values and some measures of the goodness of fit of the model are shown. The standard deviations are significant for all the coefficients, which imply that the participants have heterogeneous preferences for all the evaluated attributes.

5. *The standard errors were also estimated by the Krinsky-Robb method (Krinsky & Robb, 1986, 1990), and the standard errors of the two methods were close.*

The coefficient for farmed pangasius is positive but insignificant, and the standard deviation is highly significant. These results indicate that pangasius on average is weakly preferred to the none-of-these alternative, while the preferences among participants are quite heterogeneous. The same pattern is evident for the MSC label, which also has a positive but insignificant coefficient and a significant standard deviation. The McFadden pseudo R^2 (McFadden, 1974) is 0.65, indicating a good fit of the model (Louviere, Hensher, & Swait, 2000).

The participants were, on average, willing to pay €20.44 per kg of wild monkfish, €18.14 per kg of wild cod, €16.46 per kg of farmed cod, €17.78 per kg of farmed salmon, but only €0.29 per kg of farmed pangasius. For monkfish, salmon, and cod, these prices are in line with the prices found in the market for fish of similar quality at the time of the experiment. The average WTP for pangasius is insignificantly different from zero, which is a result of few participants choosing pangasius in the experiment.

The participants were, on average, willing to pay an additional €0.80 per kg of MSC-labeled fish and an additional €1.84 per kg of AB-labeled fish. The premium for the MSC label is about 4% for wild cod and the premium for the AB label is about 11% for farmed cod. The WTP value for the AB label is significant at the 1% level of significance, while the WTP value for the MSC label is only significant at the 10% level of significance.[6] The higher premium for the AB label may be explained by a higher degree of familiarity with this label. While 61% of the participants claimed to have seen the AB label often before the experiment, only 10% of the participants claimed to have seen the MSC label often before the experiment. These premia we find in France are somewhat below the premia found for labeled Alaskan pollock in the UK (Roheim et al., 2011) and labeled salmon in Norway (Olesen et al., 2010).

Negative environmental information reduces the WTP by about €2.20 per kg of fish regardless of labeling. This reduction suggests that the MSC and AB labels do not fully mitigate the effects of negative environmental information. Furthermore, the negative effects of information are larger than the positive effects of the labels. These results indicate that the labeling organizations still have work to do informing consumers about their labels and their credibility. The WTP values for wild cod, farmed cod, and farmed salmon when the fish is unlabeled or ecolabeled and with or without the provision of the information are summarized in Figure 1.

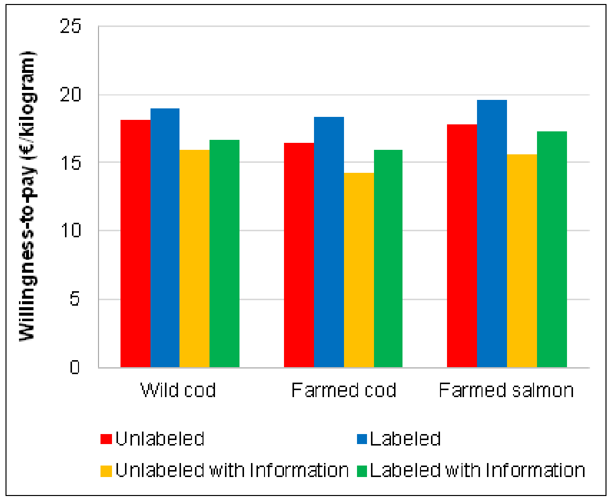

Figure 1. Direct effect of negative information.

We also find some indirect effects of labeling on the substitutes of the ecolabeled fish. As discussed above, these effects may be different for: (i) ecolabeled fish that is produced with the same production technology, (ii) ecolabeled fish that is produced with the other production technology, (iii) unlabeled fish that is produced with the same technology, and (iv) unlabeled fish that is produced with the other production technology. First, there is a positive effect on the WTP for fish that is produced with the same production technology as the fish that received the negative information. The effect is about €1 per kg and the magnitude is independent of the labeling of the substitute fish. It indicates that the participants do not generalize negative information concerning the production technology, which is used for one species, to other species produced by using the same technology. For example, negative information about salmon farming results in an increase of the WTP for farmed cod, and negative information about cod farming results in an increase of the WTP for farmed salmon. Rather surprisingly, the effect is only significant at the 10% level when the substitute is ecolabeled, while it is significant at the 5% level when the substitute is unlabeled.

Second, there is an unexpected negative and significant effect of information on the WTP for substitutes produced by the other production technology when the substitute is unlabeled; however, this effect becomes insignificant when the substitute is ecolabeled. The result seems to suggests that, for example, negative

6. *Because the model already contains a large number of parameters, we do not estimate the specific effects of ecolabels for farmed cod and farmed salmon.*

environmental information about salmon farming reduces the WTP for unlabeled wild cod while there is no significant effect on ecolabeled wild cod.

Conclusions

Ecolabels provide important information about ecological, environmental, and sustainability aspects that consumers can use in their decision-making process. Consumers' preference and WTP for ecolabeled fish is important for the adoption rate of ecolabels among fish producers and retailers. We find WTP premiums for ecolabeled wild and farmed cod and ecolabeled farmed salmon. The average participant is willing to pay a premium of about 4% for MSC-labeled wild cod and a premium of about 11% for AB-labeled farmed cod and farmed salmon. Such premiums encourage producers and retailers to implement and seek ecolabeling of their products and thereby improve the ecological, environmental, and sustainability aspects of fisheries and aquaculture. However, we also find that negative environmental information reduces the WTP with a larger amount than the premiums of the ecolabels regardless of whether the fish is ecolabeled or not. This suggests that the consumers' trust in the included ecolabels is limited. When consumers receive negative environmental information from other sources, the ecolabels do not have the intended shielding effect. Instead of flocking to the ecolabeled products, the consumers become more skeptical about both unlabeled and labeled products.

The ecolabeling organizations need to improve consumers' trust in their ecolabeled products. Increased trust will be beneficial for consumers, the fishery and aquaculture sectors, retailers, and the government. Consumers can trust that they have sustainable, ecological, and environmentally friendly products to choose from, even after receiving negative information about wild fisheries or aquaculture. This is likely to increase the fish consumption. Increased consumption of fish will benefit the producers and retailers as well as public policy goals related to the health benefits of increased fish consumption, sustainable resource management, and rural settlement.

Building trust may be a costly activity for the labeling organizations. However, increased trust will result in higher WTP for the fish and increased fish sales. Some of the increased revenues will be paid back to the labeling organizations for their labeling services.

Public authorities can also play a more active role in developing trust in ecolabels. The ecolabels are mainly voluntary, and they are developed and owned by the producers or third-party non-governmental organization such as the Aquaculture Stewardship Council. By cooperating with ecolabeling organizations and the fish industry, public authorities can contribute towards increasing consumer knowledge and trust in the ecolabels. Such cooperation may also increase the credibility of the labeling organizations and their labels among many consumers. Furthermore, tension between some of the non-governmental organizations and the fish industry may be reduced. For example, the WWF advises consumers to boycott Atlantic farmed salmon due to environmental concerns. Given more cooperation, such boycotts could be avoided. Finally, if labeling efforts prove to be insufficient, public authorities may enforce stricter environmental standards in wild fisheries as well as aquaculture.

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Appendix: The Information Treatments

This is an English translation of the information treatments, as the original transcript was written in French. The information is based on critical environmental information found on the web pages of various environmental groups.

Treatment 1: Negative Information about Cod Farming

Cod is one of the favorite fish species among French consumers. The high demand for cod has led to intense exploitation where catches have exceeded the renewal rates. As a result, the stocks of cod declined severely in the late 1990s. Cod farming (aquaculture) appears to be a possible solution this problem. Nevertheless, cod farming conducted in its natural surroundings may have negative impacts on the environment and can lead to the following:

- Pollution of the sea and the seabed. This pollution can be caused by waste from farming, uneaten feed, parasites, diseases, and injuries that are a consequence of overpopulation in the breeding cages, and by therapeutic chemicals used to treat diseases.
- A risk of breeding between farmed cod that have escaped and wild cod. This may lead to uncontrolled genetic modifications of the wild cod with unknown consequences.
- Overexploitation of other species of fish. The feed of farmed cod is primarily made from small fishes. Three to five kilograms of fish are needed to produce one kilogram of cod. The species used for feed were considered to be inexhaustible; however, the strong growth of fish farming may put the sustainability of these species at risk.
- Damage to other species. Some fish farming is protected from birds and other predators by nets, but these nets can also capture protected species.
- Damage to the seabed. Farming can particularly damage the flora close to production sites.

Treatment 2: Negative Information about Wild Cod Fisheries

Cod is one of the favorite fish species among French consumers. The high demand for cod has led to intense exploitation where catches have exceeded the renewal rates. As a result, the stocks of cod declined severely in the late 1990s. Even though recent scientific observations of the stocks of cod are encouraging, industrial fisheries may have negative impacts on the environment and can lead to the following:

- A decrease of the fish resources. Industrial cod fisheries lead to the capture of other non-targeted (sometimes protected) species and of undersized fish. These captures, without any market value, are often discarded (dead) at sea.
- The death of other animals. Secondary captures of mammals and sea birds (including dolphins, albatross, etc.) occur. These animals die trapped in the nets or on lines with fishhooks.
- An imbalance of the marine ecosystem caused by the decrease of other marine species.
- Damage to the seabed. Some fishing techniques damage the flora (including seaweeds and corals), disturb the seabed, and destroy habitats.
- Social and economic effects. Due to the decrease of marine resources, the number of people employed in fishing activities is continuously decreasing. Increasingly, public subsidies try to support fishing activities since some of the fishing activities are unprofitable.

Treatment 3: Negative Information about Cod Farming and Wild Cod Fisheries

Cod is one of the favorite fish species among French consumers. The high demand for cod has led to intense exploitation where catches have exceeded the renewal rates. As a result, the stocks of cod declined severely in the late 1990s. Even though recent scientific observations of the stocks of cod are encouraging, industrial fisheries may have negative impacts on the environment and can lead to the following:

- A decrease of the fish resources. Industrial cod fisheries lead to the capture of other non-targeted (sometimes protected) species and of undersized fish These captures, without any market value, are often discarded (dead) at sea.
- The death of other animals. Secondary captures of mammals and sea birds (including dolphins, albatross, etc.) occur. These animals may die trapped in the nets or on lines with fishhooks.
- An imbalance of the marine ecosystem caused by the decrease of other marine species.
- Damage to the seabed. Some fishing techniques damage the flora (including seaweeds and corals), disturb the seabed, and destroy habitats.
- Social and economic effects. Because of the decrease of marine resources, the number of people employed in fishing activities is continuously decreasing. Increasingly, public subsidies try to support fishing activities since some of the fishing activities are unprofitable.

Cod farming (aquaculture) appears to be a possible solution to some of these problems. Nevertheless, cod farming conducted in its natural surroundings may have negative impacts on the environment and can lead to the following:

- Pollution of the sea and the seabed. This pollution can be caused by waste from farming, uneaten feed, parasites, diseases, and injuries that are a consequence of the overpopulation in the breeding cages and the therapeutic chemicals used to treat diseases.
- A risk of breeding between the farmed cod that have escaped and wild cod. This may lead to uncontrolled genetic modifications of the wild cod with unknown consequences.
- Overexploitation of other species of fish. The feed of farmed cod is primarily made from small fish. Three to five kilograms of fish are needed to produce one kilogram of cod. The species used for feed were considered to be inexhaustible; however, the strong growth of fish farming may put the sustainability of these species at risk.
- Damage to other species. Some fish farming is protected from birds and other predators by nets, but these nets can also capture protected species.
- Damage to the seabed. Farming can particularly damage the flora close to production sites.

Treatment 4: Negative Information about Salmon Farming

Salmon is one of the favorite fish species among French consumers. The stocks of wild salmon collapsed in the late 1980s after catches exceeded the renewal rates. Then, fishing was dramatically reduced and present catches are among the lowest ever registered. Salmon farming (aquaculture) appears as a possible solution to this problem. Nevertheless, salmon farming conducted in its natural surroundings may have negative impacts on the environment and can lead to the following:

- Pollution of the sea and the seabed. This pollution can be caused by waste from farming, uneaten feed, parasites, diseases, and injuries that are a consequence of overpopulation in the breeding cages and the therapeutic chemicals used to treat diseases.
- A risk of breeding between farmed salmon that have escaped and wild salmon. This may lead to uncontrolled genetic modifications of the wild cod with unknown consequences.
- Overexploitation of other species of fish. The feed of farmed salmon is primarily made from small fish. Three to five kilograms of fish are needed to produce one kilogram of salmon. The species used for feed were considered to be inexhaustible; however, the strong growth of fish farming may put the sustainability of these species at risk.
- Damage to other species. Some fish farming is protected from birds and other predators by nets, but these nets can also capture protected species.
- Damage to the seabed. Farming can particularly damage the flora close to production sites.