PrimeFish

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[2] PU: Public, PP: Restricted to other programme participants (including the Commission Services), RE: Restricted to a group specified by the consortium (including the Commission Services), CO: Confidential, only for members of the consortium (including the Commission Services)

[3] The initials of the revising individual in capital letters

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Deliverable D5.5

Innovation and price analysis model

February 2018

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Executive Summary

Building on the consumer analysis conducted in WP4 and in particular in Task 4.4, this deliverable provides a deeper analyse of the willingness-to-pay (WTP) of consumers, and consequently the price that producers may charge in different markets. This has been done by analysing in-depth the relationship between the various product attributes and WTP.

In particular, we have provided three deeper analysis, namely 1) the WTP estimates by segment, for each country, included in Table 1; 2) own-and cross-choice market elasticities, for each species, country and segment, included in Table 2; and 3) competitive clout and vulnerability score, estimated for each species, country and segment.

Finally, this deliverable also provides instructions, already circulated to the Syntesa partners, on how to implement these models into the PrimeDSS in WP6.

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1. Introduction

Building on the consumer analysis conducted in WP4 and in particular in Task 4.4, this deliverable will provide a deeper analysis of the willingness-to-pay (WTP) of consumers, and consequently the price that producers may charge in different markets. This will be done by analysing in depth the relationship between the various products' attributes and WTP. This deliverable also provides instructions, already circulated to the Syntesa partners, on how to implement these models into the PrimeDSS in WP6.

2. Methods

We first discuss the methodology used for the in-depth analysis of the data collected in Task 4.4.

2.1 WTP by segment (Table 1)

In Table 1, we report the WTP estimates by segment, for each country. The segments have been derived by the individual consumers' choice probability. The segments, as discussed in D4.7 (Menozzi et al., 2017), are derived in every country using SAS macros, and three parameter criterions: cubic clustering criterion (Sarle, 1983), Pseudo-F statistics (Calinski and Harabasz, 1974), and Pseudo-t squared statistics (Duda and Hart, 1973).

The WTP estimates for each segment have been derived using the variability across the clusters of the WTP for each fish species and single attribute (see Menozzi et al., 2017, Tables 13, 19, 25, 31 and 37) and the WTP specific for every attribute level and species (as reported in Menozzi et al., 2017, Tables 9, 15, 21, 37 and 33).

2.2 Price elasticities (Table 2)

We use the parameters and choice probability at the individual consumer level to estimate a matrix of the choice share elasticity. The share elasticity measures the change in market share of a seafood product associated with the change of one unit of the marketing mix variables (*e.g.,* price). We first estimate the choice elasticities at the individual consumer level and then aggregate the *choice* elasticities to *share* elasticities for each segment and for the entire market.

Our calculations of individual own-and cross-choice elasticity are similar to previous studies (*e.g.,* Thong et al., 2017; Train, 2003; Bucklin, Russell, & Srinivasan, 1998). The own-choice

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elasticity (e_{iitq}) that measures a change in choice probability of consumer *q* for seafood *i* in choice set *t* associated with a change in the price of that seafood is calculated as:

$$e_{iitq} = \hat{\beta}_q(1 - \hat{P}_{itq})X_i \quad (1)$$

The cross-price choice elasticity (e_{ijtq}) that measures a change in choice probability of consumer *q* for seafood *i* in the choice set *t* associated with a change in the price of seafood *j* is

$$e_{ijtq} = \hat{\beta}_q \hat{P}_{jtq} X_j \text{ , for i} \neq \text{j} \quad (2)$$

where X_i and X_j are the price levels for seafood i and j, respectively. The elasticities, therefore, are point elasticities. To aggregate the individual choice elasticities to the market share elasticities, we define the market share of seafood *i* as

$$MS_i = \frac{\sum_q \sum_t \hat{P}_{itq}}{Q*T} \quad (3)$$

where Q is the total number of consumers in the sample and T is the total number of choice situations (choice sets) passed to each consumer. The market share elasticity is defined as

$$e_{ij} = \frac{\partial MS_i}{\partial X_j} \frac{X_j}{MS_i} \quad (4)$$

Using the definition of market share MS_i, it follows that the own-market share elasticity is

$$e_{ii} = \frac{\sum_q \sum_t \hat{P}_{itq} e_{iitq}}{\sum_q \sum_t \hat{P}_{itq}} \quad (5)$$

and cross-market share elasticity is

$$e_{ij} = \frac{\sum_q \sum_t \hat{P}_{itq} e_{ijtq}}{\sum_q \sum_t \hat{P}_{itq}} \text{ , for i} \neq \text{j} \quad (6)$$

Obviously, the market-share elasticities are simply weighted averages of the individual choice elasticities with the weight $w_{itq} = \hat{P}_{itq} / \sum_q \sum_t \hat{P}_{itq}$. The weight ($w_{itq}$) reflects consumer *q*'s importance in determining seafood *i* share in choice set *t*. The consumer's weights for seafood *i* are different from those for seafood *j*. The equations (5) and (6) can be applied to calculate the segment share elasticities.

Because the market share of all seafood changes resulting from a change in the price of seafood j must add to zero, the elasticities satisfy the constraint $\sum_i MS_i e_{ij} = 0$. Further, if all seafood species were to change their prices by the same percentage and holding all other

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things constant, market shares would be unchanged, which means $\sum_j e_{ij} = 0$ (Train, 2003; Bucklin, Russell, and Srinivasan, 1998)[4].

In the standard MNL model, the cross-elasticity is the same for all alternatives i ≠ j, namely *uniform cross elasticities*, due to the IIA property (Thong et al., 2017; Train, 2003). It means that a change in price of alternative j changes the probabilities for all other alternatives by the same proportion. This property of cross-elasticity estimated in a MNL is irrelevant for marketing practice. However, in our study the cross-elasticity differs across seafood alternatives as expressed in equation 6.

2.3 Competitive clout and vulnerability score (Table 3)

Cross-elasticity calculated by (6) can be used to measure the competition between seafood alternatives in the market. We employ the definition of competitive clout and vulnerability score due to Horsky, Misra, & Nelson (2006) and Kamakura & Russell (1989) for understanding the market positions among products. The competitive clout report the ability of a seafood product to take share away from the competitors, while the vulnerability score report the degree to which a seafood product is vulnerable to its competitors.

$$Competitive\ clout\ of\ seafood\ i = \sum_j e_{ji}^2 \ \ for\ i \neq j \qquad (7)$$

and

$$Vulnerability\ score\ of\ seafood\ i = \sum_j e_{ij}^2 \ \ for\ i \neq j \qquad (8)$$

Thus, competitive clout is a function of the sum of squares of the cross-elasticities of the other seafood with respect to the price of seafood *i*. Vulnerability score is a function of the sum of squares of the cross-elasticity of seafood *i*'s share with respect to the other seafood price. The price change of the seafood with considerable competitive clout has a major impact on the shares of the other seafood. By contrast, seafood with high vulnerability score would suffer substantial change of the share in response to price changes of the other seafood.

Competitive clout and vulnerability score can be used to analyse the position of the seafood species within segments and for the entire market. We will demonstrate the implication of these calculated indicators as well as intrinsic value or species effects to study competitions among seafood products.

[4] In the LCEs including "Non-option" the own-and cross-price elasticities estimated will not be estimated for the "None-option", therefore, these constraints will not be satisfied, as shown in the Table 3 of this study.

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3. Results

The results are reported in the Excel file attached to the present deliverable D5.5. The three tables (Table 1, Table 2 and Table 3) have been derived for every country. In total, 15 Tables have been generated.

Competitive clout and vulnerability score have been used to analyse the position of the seafood species within segments and for the entire market. We have plotted the competitive clout versus vulnerability score for the entire market in a figure for every country. The figure is known as a market positioning map (Kamakura and Russell, 1989), which portrays clearly the market positions of the seafood alternatives. Notice that the size of the bubble is proportional to the overall market share of the seafood species.

As an example, Figure 1 shows the market positioning map for the French case.

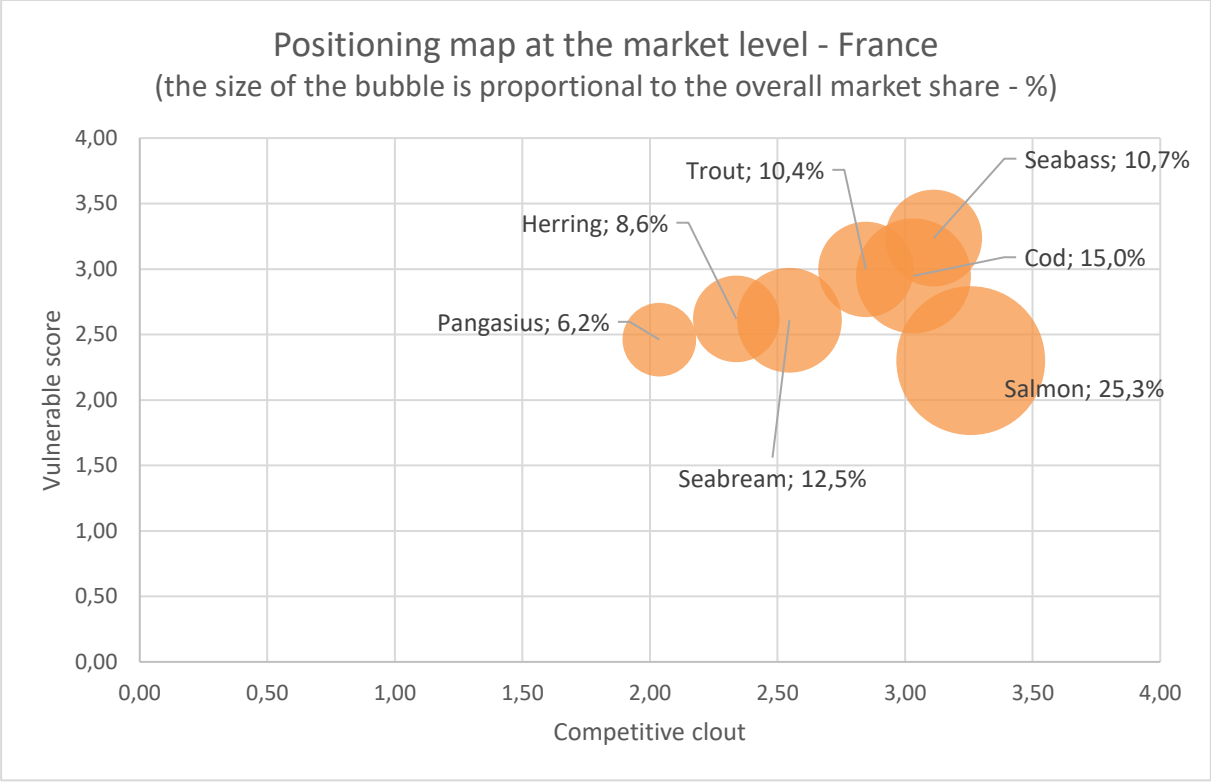

Figure 1: Market positioning map, France.

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4. How to incorporate the WTP results into the PrimeDSS

Besides this in-depth analysis of the relationship between the various product attributes and WTP, we have provided instructions to Syntesa on how to implement these outcomes, and those of D4.7 (Menozzi et al., 2017) and Task 4.4 activities, into the PrimeDSS in WP6.

First, we have provided a pilot guideline about the algorithm to be applied to integrate the WTP estimates in the PrimeDSS. Then, we have provided a short methodological note, based on the first version of the PrimeDSS (as circulated with email in January 2018), to be included in the DSS.

4.1 The pilot test with the WTP results

We have explained how to derive the WTP values for product profiles, starting from the original values provided in the deliverable D4.7 (Menozzi et al., 2017). This pilot test was provided with the Italian results only, and with only 3 product profiles as an example. The Excel file with the data and the formulas applied for these four products was attached.

Table 1 Willingness-to-pay of Italian consumers. €/kg.

Attribute	Level	Trout	Herring	Salmon	Seabream	Seabass	Cod	Panga
Price	Average	10.51	9.90	15.10	10.82	11.82	12.21	5.60
Production method	Farmed	0.00	n.a.	0.00	0.00	0.00	0.00	0.00
	Wild caught	n.a.	0.00	7.33	2.19	4.03	4.78	n.a.
Format	Ready-to-cook	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Whole/Round cut	-0.49	-1.66	5.72	1.44	-0.37	-3.68	-1.22
	Fillet	-2.92	-0.52	10.69	1.54	-1.53	1.17	-0.20
Sustainability	None	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sustainability label	1.49	2.02	1.42	1.78	0.86	3.32	1.18
Nutrition and health	None	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Nutritional and Health claim	0.78	1.14	3.19	2.91	1.38	1.71	0.96

n.a.: not available.

To derive the WTP for selected product profiles, you should sum up the relative marginal values (i.e. the numbers in the cells), by fish species (i.e. by column).

You can select one value for each attribute (identified with different colours); blanks are impossible selections (i.e. wild caught trout alternative cannot be selected).

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The "Average price" row refers to the base product (e.g. Trout + Farmed + Ready-to-cook + None sustainability + None Nutritional and Health); indeed, by summing up these values you get the average price (see Product 0 in the Excel file).

Other combinations can be derived by summing up the values in the cells, by column, having care to select only one level per attribute.

For instance, the WTP for the following product alternatives can be derived with simple calculations:

Table 2 Willingness-to-pay of Italian consumers. €/kg.

Product	**Profile**	**WTP**
Product 1	Trout, Farmed, Whole, Sustainability label	11.50 €/kg
Product 2	Salmon, Wild-caught, Ready-to-cook, Nutritional and Health claim	25.62 €/kg
Product 3	Seabass, Farmed, Fillet, Sustainability label	11.14 €/kg

The Excel file reports the calculations.

To be more appealing, it was suggested to use the pictures to show the product formats (i.e., ready-to-cook, whole/round cuts, fillets – see Deliverable D4.7, Table A3, pages 67-71).

4.2 Methodological note to the first version of the PrimeDSS

4.2.1 The method applied

In this part of the DSS we have applied a methodology called "choice modelling", where consumers participating in an online experiment have indicated their preference on a set of goods (see the picture below). While choosing one alternative instead of another, consumers indicate their preference on a fish species (e.g., cod), and on a particular combination of the following characteristics (what we call "attributes"): price, production method (farm-raised or

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wild-caught fish), presentation format (whole fish, fillet, ready-to-cook), sustainability label[5], and nutritional and health claim[6].

A mathematical model helped us to estimate how each product attribute (including fish species) has contributed to drive consumers' choices. Based on these calculations, we could estimate the consumer willingness-to-pay for every attribute in the experiment, and the total WTP for a given product with the selected characteristics.

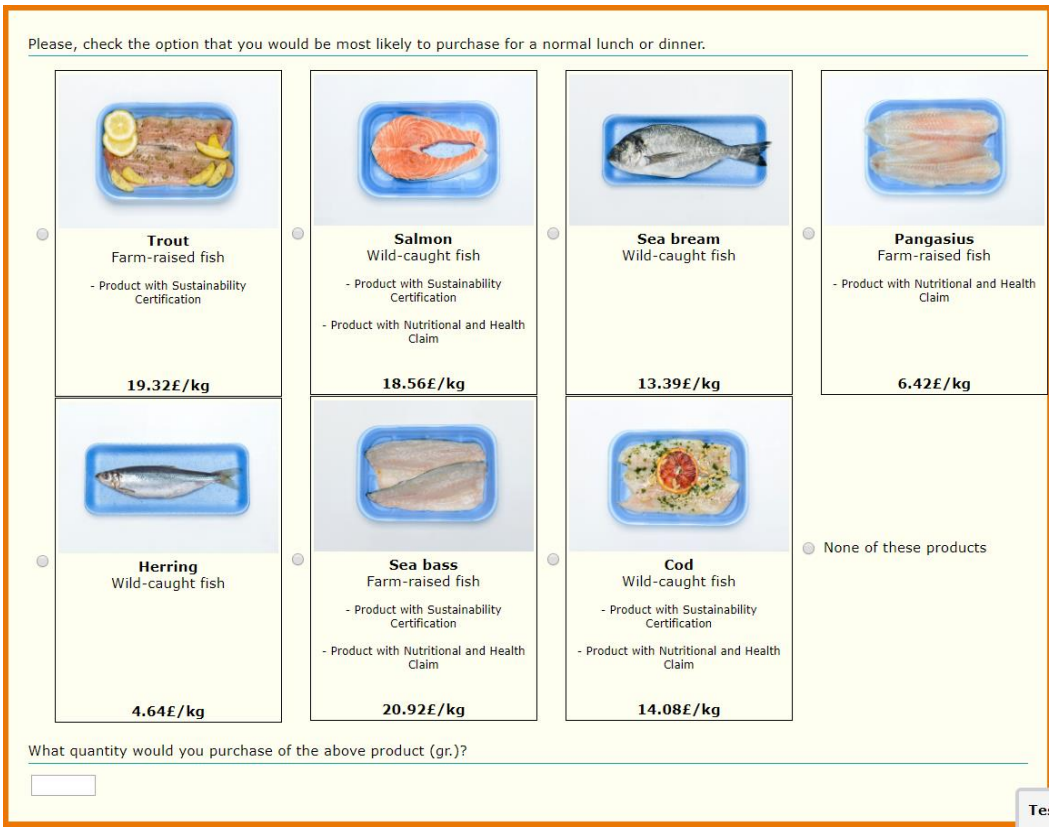

Figure 2. Willingness-to-pay by product types. €/kg.

[5] Respondents received the following definition for sustainable label: "When certified according to a sustainability scheme, any fish can be traced back to a fishery or to a fish farm that meets principles reflecting the maintenance and re-establishment of healthy populations of targeted species, the maintenance of the integrity of ecosystems, the use of feed and other inputs that are sourced responsibly, and the social responsibility for workers and communities impacted by fishing and fish farming. This standard is intended to be used on a global basis by accredited third party certifiers to undertake the certification of fisheries and fish farmers to the above-mentioned principles and criteria".

[6] Respondents received the following definition for nutritional and health claim: "Product high of omega 3 fatty acids which contributes to maintenance of normal function of the heart and normal blood pressure", with the following condition of use: "the beneficial effect is obtained with a daily intake of 250 mg of omega 3 fatty acids. Such amount can be consumed as part of a balanced diet".

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4.2.2 How to interpret the WTP values

Based on the consumers choices, we could estimate the WTP for every attribute included in the experiment. The WTP values are expressed in €/kg (£/kg in the UK case):

The WTP values associated to every fish species (the first rectangle on the left-hand side, e.g., seabass) indicate the average market price in that country, for that fish species. In the example, the average market price for seabass in Italy is 11.82 €/kg.

The WTP values associated to every product attribute (the following rectangles, e.g., wild-caught) indicate the price respondents are willing to pay for a change in the attribute level. For instance, from exchanging a farm-raised with a wild-caught seabass, respondents in Italy are willing to pay extra 4.03 €/kg. For the sustainability labelling respondents are willing to pay 0.86 €/kg, etc. When a negative value is displayed (the rectangle becomes red, such as fillet in the example), it means that the alternative attribute level (in this case, "ready-to-cook" product) is preferred, and consumers are willing to accept a discount to buy the less preferred choice. In the example above, consumers would accept a seabass fillet, instead of the ready-to-cook alternative, with a discount of 1.53 €/kg (in other words, the price they're willing to pay for the ready-to-cook product is higher).

With total WTP (the rectangle on the right-hand side) we mean willingness-to-pay to go for a change in several attributes, and is calculated by summing up the single WTP values associated with the selected attributes. In the example above, the total WTP of Italian consumers for a wild-caught seabass fillet, with sustainability labelling and nutritional and health claim is 16.56 €/kg, which is about 40% higher than the average (initial) price (i.e. 11.82 €/kg).

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In any case, the WTP values associated to a specific attribute have to be interpreted as the price respondents are willing to pay for a change in the attribute from one value (the base level) to another one. The base values have WTP equal to 0 (see the Table 3 below).

Table 3 Base value for the willingness-to-pay of Italian consumers.

Attribute	Base level	Alternative attribute level
Production method	Farmed	Wild
Presentation format	Ready-to-cook	Fillet
Presentation format	Ready-to-cook	Whole / round cut*
Sustainability labelling	No	Yes
Nutritional and health claim	No	Yes

* Whole for Trout, Herring, Seabream, Seabass and Cod; Round cut for Salmon and Pangasius.

Figure 3 shows how the WTP varies across the attribute levels for seabass in Italy (values are expressed in €/kg, £/kg for the UK).

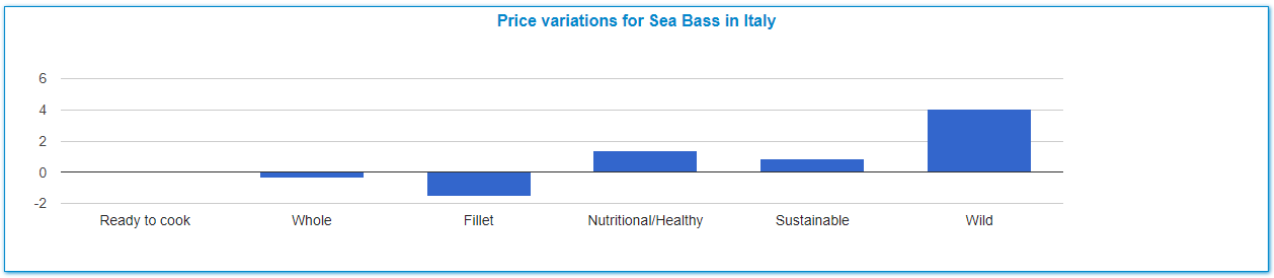

Figure 3. Willingness-to-pay for different attributes of seabass. Italian consumers. €/kg.

Figure 4 shows the consumers WTP in Italy for the seven species with the same attributes chosen for the seabass (values are expressed in €/kg, £/kg for the UK).

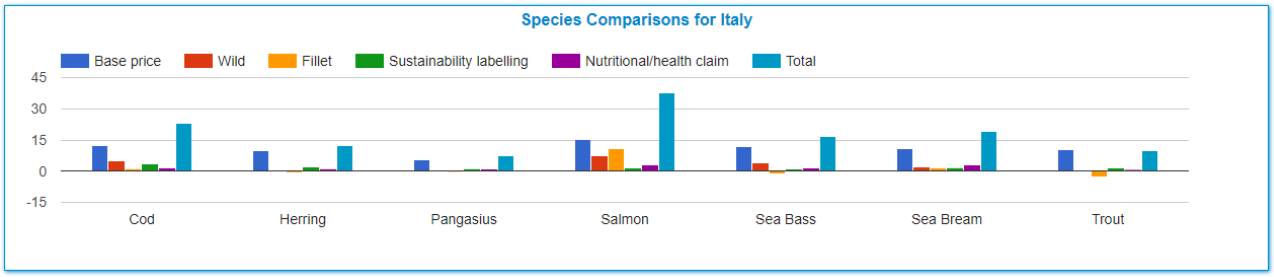

Figure 4 Willingness-to-pay for attributes of different species. Italian consumers. €/kg.

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5. Conclusions

Building on the consumer analysis conducted in WP4 and in particular in Task 4.4, this deliverable has provided a deeper analyse the willingness-to-pay (WTP) of consumers, and consequently the price that producers may charge in different markets. This has been done by analysing in-depth the relationship between the various product attributes and WTP, in each country.

In particular, we have provided three deeper analysis, i.e. 1) the WTP estimates by segment, for each country, included in Table 1; 2) own-and cross-choice market elasticities, for each species, country and segment, included in Table 2; and 3) competitive clout and vulnerability score, estimated for each species, country and segment.

Finally, this deliverable has also provided instructions, already circulated to the Synthesa partners, on how to implement these models into the PrimeDSS in WP6.

6. Acknowledgement

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