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Proceedings in
System Dynamics and Innovation in Food Networks 2017

INTERNATIONAL JOURNAL ON FOOD SYSTEM DYNAMICS

Future Developments in German Fish Market – Integration of Market Expert Knowledge into a Modelling System

Laura Angulo*, Petra Salamon*, Martin Banse*, Ralf Döring**, Matthias Keller***, Myrna Van Leeuwen****

** Thünen Institute of Market Analysis, Bundesallee 50, 38116 Braunschweig*
*** Thünen Institute of Sea Fisheries, Palmaille 9, 22767 Hamburg*
****Bundesverband der deutschen Fischindustrie und des Fischgroßhandels e.V., Große Elbstraße 133, 22767 Hamburg*
*****Wageningen Economic Research, International Policy, Alexanderveld 5, 2585 DB The Hague*

laura.angulo@thuenen.de, petra.salamon@thuenen.de, martin.banse@thuenen.de, ralf.doering@thuenen.de, info@fischverband.de, Myrna.vanLeeuwen@wur.nl

ABSTRACT

Globally fish has become more important in the human nutrition, thus global consumption is expected to highly increase in the future years. Business-as-usual projections for fish market are limited by availability of reliable data that hinders the differentiation on fish category level on the supply and demand side and across EU member states. The Fishmodul in AGEMEMOD provides long term predictions for the fish market by fish categories at EU member state level. For this, a status-quo simulation to the year 2030 is developed in AGMEMOD. Additionally, opinions of market experts from private sector and research institutions through interviews and an elaborated questionnaire is integrated into the model to deal with the insufficient information. Thus, expertise knowledge provides better and accurate information of the sector for market projections. As results, baseline projections were adjusted, showing a slowly increase over the years, but higher production level by 2030.

Keywords: *Fish model, AGMEMOD, partial –equilibrium model, baseline projections, market expert knowledge*

1. INTRODUCTION

Fish serves as an important component in human consumption. According to the FAO (2016), fish represented about 17 percent of all protein consumed globally in 2013, and fish consumption is still dramatically increasing. Global per capita consumption of all fish grew to reach over 19 kg per head and year. The World Bank expects that by 2050, global population reaches 9 billion. This, together with growing standard of living and increasing demand for animal protein will lead to even significantly higher fish consumption (Msangi et al., 2013). To satisfy such high demands, fish production would have to increase globally by 60 percent by 2050. However, output of the world wild fisheries has become stagnant. FAO (2012) estimated that about 57.4 percent of world marine fish resources are fully and 29.9 percent are already over exploited and overall landings have reduced over the last years. In this context, aquaculture has to capture a main role to push the global fish supply. In 2015, aquaculture contributes about 30 percent to total world fish production (FAO, 2016).

With respect to the EU member states, for example, imports cover 73 percent of their total fish demand in volumes. Currently, EU's domestic production only stems to 10 percent from aquaculture. An expected growth in aquaculture production will influence significantly price dynamics on fish markets and substitution between wild fish and aquaculture. Moreover fish production and consumption trends highly differ across categories and countries influencing price formation. Thus, business-as-usual projections for fish supply and demand are

DOI: http://dx.doi.org/10.18461/pfsd.2017.1710

needed to derive ex-ante impacts of e.g. policy reforms, innovations in products and production systems, and consumer preferences.

To cover future changes in supply and demand of fish products models are applied such as the IMPACT Model (Delgado, 2003), the Asia Fish Model (Dey, 2008) or the Aglink-Cosimo model (OECD-FAO, 2016). However, those models are highly aggregated and do not spell out prospects across different EU member states and fish categories, although they may disaggregate in supply on category level. The fact is driven by data availability which allows a differentiation mostly on the supply side. This paper deals with a differentiation of markets for a number of categories across member states drawing on information of experts to compensate for data gaps and validation. Thus the paper aims explore possibilities 1) to further disaggregate fish categories and to 2) validate production and demand projections based on opinion of market experts.

2. METHODS

At a more disaggregated level a differentiation between wild and aquaculture fish becomes even more desirable as future trends are quite divers across the different segments. Therefore, fish markets by categories are implemented in an existing partial equilibrium model framework, based on a database with annual data for fish categories in member states. This fish module in AGMEMOD (AGriculture MEmber states MODelling, details see Chantreuil et al., 2012)) covers seven fish categories (cephalopods; crustaceans; demersal marine fish; pelagic marine fish; molluscs excl. cephalopods; other marine fish species; freshwater and diadromous fish) for EU member states and other selected countries developed under the SUCCESS[1] project. Use of such a modelling system will allow an implementation of interactions with agriculture at a later stage. Comparable to Aglink-Cosimo a differentiation between production systems, aquaculture and capture fishery, is possible only on the supply but not on the demand side.

Currently, the AGMEMOD fish module includes endogenous variables describing the supply, demand and price formation for each of the seven distinguished categories. Specific prices are represented to describe varying supply and demand conditions for both production types. Based on the diverting composition of trade within the fish categories across countries the use of unit values as price proxy lead to significant differences across the EU member states. Unfortunately, on the demand side a differentiation between capture and aquaculture is impossible due to insufficient information. Therefore, the demand is only expressed by one aggregate commodity, without distinguishing its source (capture, aquaculture). Trade behaviour is designed as net-export (NETEXP); in our model the variable is calculated as the difference between total supply and total domestic use. Table 1 describes the variables defined in the AGMEMOD fishery module.

Table 1. Variables defined in AGMEMOD fishery markets

Supply Variables	Description
(1) $SUPPLY_{cc,comm}$	Total supply for category *COMM* in country *CC*
(2) $PROD\_TYPE_{cc,comm,"SPRa"}$	Production of aquaculture fish category *COMM* in country *CC*
(3) $PROD\_TYPE_{cc,comm,"SPRc"}$	Production of caught fish category *COMM* in country *CC*
Demand Variables	
(4) $HDEM_{cc,comm}$	Total human demand for total fish category *COMM* in country *CC*
(5) $TUSE_{cc,comm}$	Total domestic use for total of category *COMM* in country *CC*
Price Variables	
(6) $PD_{cc,comm}$	Domestic market prices for category *COMM* in country *CC*
(7) $PC_{cc,comm}$	Domestic consumer prices for category *COMM* in country *CC*
(8) $PI_{cc,comm,fishprods}$	Producer incentive price (fishery price *plus* any premium) of aquaculture and caught fish category *COMM* in country *CC*
(9) PW_{comm}	World market price for tradeable category *COMM*

[1] Strategic Use of Competitiveness towards Consolidating the Economic Sustainability of the European Seafood Sector, European Research Project under H2020.

DOI: http://dx.doi.org/10.18461/pfsd.2017.1710

Other Market Variables	
(10) $NETEXP_{cc,comm}$	Net exports (supply *minus* domestic use) of category *COMM* in country *CC*

Source: Own compilation.

The endogenous variables on the demand side are directly influenced by the variation on prices, population, income and consumption trends. The supply side variables are affected by technological changes in production, prices, capital and labour costs (see Table 2 and Table 3). Please note, that the current model template does not yet capture any policy measures, nor any fish stock representation.

Table 2. Parameters defined in AGMEMOD fishery markets

Parameters		**Description**
Consumption trend	$hdem\_tr_{cc,comm}$	Trends in private consumption of category COMM in country *CC*
Population	pop_gr_{cc}	Population growth rate in country *CC*
Income	inc_gr_{cc}	Income growth rate in country *CC*
Technical progress	$tp\_gr_{cc,comm}$	Technical progress in supply of category COMM in country *CC*
Capital Cost Index	$cap\_ind_{cc,comm}$	Capital Cost Index by production system for category COMM in country *CC*
Labour Cost Index	$lab\_ind_{cc,comm}$	Labour Cost Index by production system for category COMM in country *CC*
Demand Elasticities		
Own price	$elasthd_{cc,i,j}$	Elasticity of human demand with respect to price in *CC*
Income	$elastin_{cc,I}$	Elasticity human demand with respect to income in *CC*
Supply Elasticities		
Cultivated fishery	$elastsp\_a_{cc,i,j}$	Elasticity aquaculture production with respect to producer price in *CC*
Caught fishery	$elastsp\_c_{cc,i,j}$	Elasticity capture production with respect to producer price in *CC*

Source: Own compilation.

Table 3. Supply and demand equations in AGMEMOD fishery market

Supply equations			
(1) Production of caught fish	$PROD\_TYPE_{indCntr,com,SPRc}$	=	$f(PI_{indCntr,comm,\ SPRc},\ tp\_gr_{indCntr,comm},\ lab\_ind_{indCntr,comm,\ SPRc},\ cap\_ind_{indCntr,comm,\ SPRc})$
(2) Production of aquaculture fish	$PROD\_TYPE_{indCntrc,com,SPRa}$	=	$f(PI_{indCntr,comm,\ SPRa},\ tp\_gr_{indCntr,comm},\ lab\_ind_{indCntr,comm,\ SPRc},\ cap\_ind_{indCntr,comm,\ SPRc})$
(3) Total fish Production	$SUPPLY_{indCntr,comm}$	=	$PROD\_TYPE_{cc,com,SPRc} + PROD\_TYPE_{cc,com,SPRa}$
Demand equations			
(4) Human demand	$HDEM_{indCntr,comm}$	=	$f(PC_{indCntr,comm},\ pop\_gr_{indCntr},\ inc\_gr_{indCntr},\ hdem\_tr_{indCntr,comm})$
(5) Total domestic use	$TUSE_{indCntr,comm}$	=	$HDEM_{indCntr,comm}$

Source: Own compilation.

Elasticities provoke different effects on demand and supply estimation in each country. For each country and fish category in the model, we have incorporated some initial elasticities taken from the literature (Asche, & Bjoerndal, 2001,Fousekis et al, 2004, Asche et al, 2005, Dey et al, 2008) , in order to get an initial starting base for the calibration procedure.

Several studies have highlighted the difficulties with respect to available and reliable data for fish. Therefore, the inclusion of market expert knowledge in projecting future trends is quite significant. Lemans (2003) for

DOI: http://dx.doi.org/10.18461/pfsd.2017.1710

example, estimated future increase of processed seafood demand in Greece but a decrease in marinated and canned products, based on industries´ executive opinions. Avdelas and Papaharisis (2006), with the help of a questionnaire, collected market experts opinions on past and future trends specially for organic and label products. Additionally, they request the validation of the historical development of the fishery market in Greece. Although there were opposing views when validating the historical statistics, experts agreed on past and future production and consumption trends. They expected a rise in aquaculture products consumption and consumption preferences subject to price of labelled products. FAO (2012) drew on an expert panel to develop a baseline in the aquaculture and fishery sector, obtaining data to include in their modelling parameters. Likewise, Dey et al (2005) implemented exogenous variables trends and drivers in the Asian Fish model based in literature review and opinion of market experts. In the same manner, Rab et al (2002) calibrated elasticities of various groups of fish species.

For this study, as data disaggregated by fish categories is not easily available, an explorative approach is tested in which market expert knowledge is exploited with the help of a questionnaire to identify fish species and groups that are more relevant for the European fish market and define the evolution path of fish demand and supply. As a result, for Germany the category demersal marine fish is firstly subdivided in flatfish and whitefish and secondly plaice is broken off from the subcategory flatfish.

This questionnaire was delivered to market experts of the fishery sector from the private sector and research institutions to obtain their opinion of the market development for each of the seven fish categories for four main variables: demand, aquaculture and capture production and import unit value. The first section of the questionnaire described the seven initial fish categories and the species each of them comprises, and the four main variables evaluated in initial baseline projection. The second section displayed figures of the evolution of the four variables for the period between 1973 projected by 2030. Market experts were asked to give their opinion regarding to the behaviour of the projected variables, and if the estimates would meet the future trends expected. Opinions confirmed the historical path extracted from the statistics, and suggested in some cases a higher increase in demand or production validated with document about forecast tendency, new regulations or even future expectations on biological stocks. Additionally, they were requested to indicate species of each group which highly influence the price dynamics, based on their work field, work papers and experience.

3. DATA

For the study, time series data on the fish sector were compiled from mainly two sources: FAO FishstatJ and FAO Food Balance Sheets (FBS). Both sources provided historical country level - data on production, demand and trade for the seven fish categories relevant for this study. Data on both production systems capture and aquaculture fishery was collected from the FAO FishstatJ updated until 2014; while demand and trade data was obtained from the FAO FBS available until 2013.

This data was adapted to be included in the market balances from AGMEMOD´S database. In this case, supply, demand and trade were presented in volume terms (thousand tonne), while prices where expressed in value terms (US$/100Kg). As prices by fish categories were not available in any of the main FAO sources, the study uses proxies based on production unit values, for aquaculture and capture fisheries, and import unit values as a demand price proxy.

Other exogenous variables and income and population growth were incorporated from the U.S. Census Bureau, International Data Base (2015). Driver coefficients, relevant elasticities and parameters where obtained from literature review and other models for the fish sector.

4. RESULTS

Figure 1 presents the new species groups integrated to the modelling system, which cover Whitefish, Flatfish and Salmonidae. Experts agree with the relevance for the fish market of these species groups and

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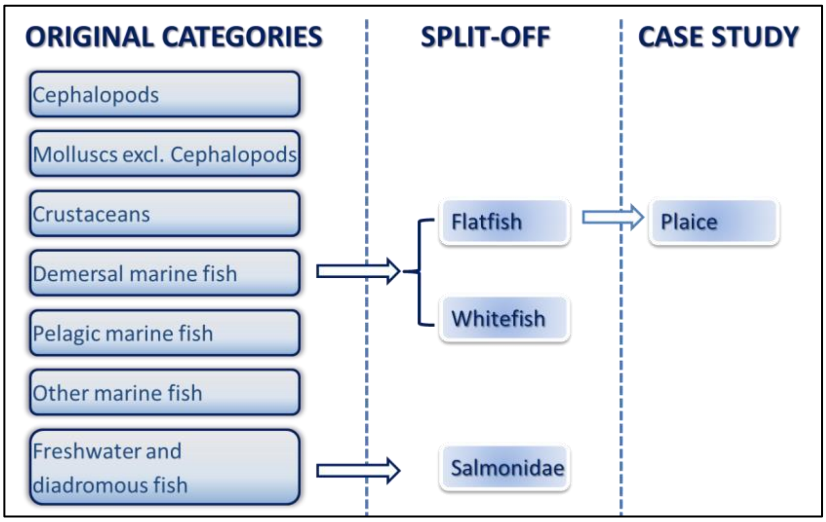
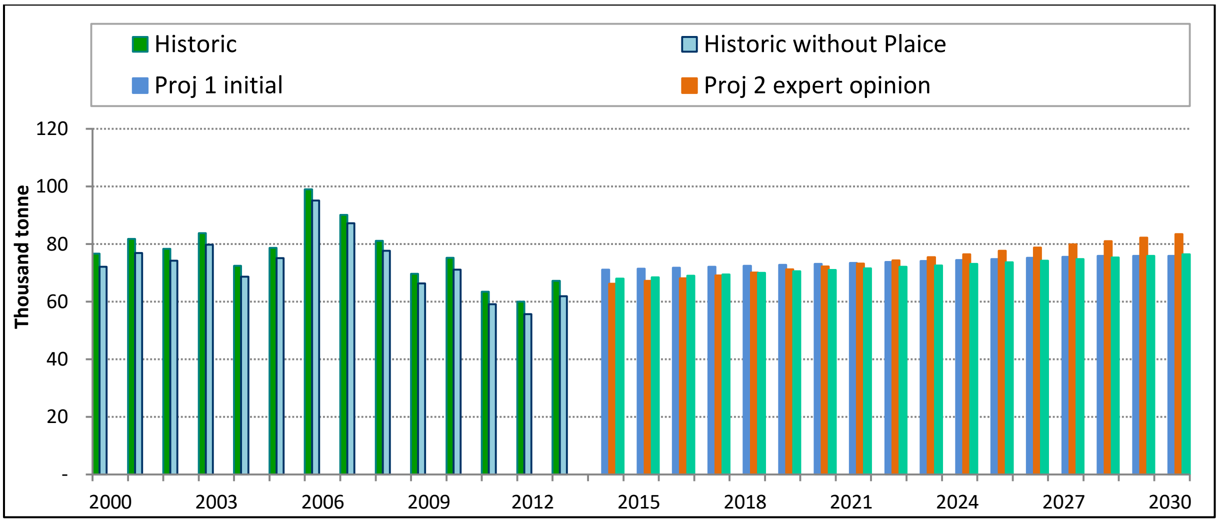
recommended to evaluated them independently. Salmon is a global commodity with a remarkable influence on the dynamics of the European market and an increasing aquaculture production. Thus, it was necessary to split-off from freshwater and diadromous fish category. In the same manner, flatfish and whitefish would be broke-off from demersal marine fish category. Flatfish production has been increasing over the years. Most trade in flatfish is between European countries. Within this group, Plaice has an especial position. As a low-value flatfish competes with other low value similar species, and its apparent consumption has been declining during the observed years.



Source: Based on own results after Experts Interviews

Figure 1. Disaggregation of fish groups after interviews with market expert

In this context, Fish production projection for Germany is conducted under three scenarios. The first scenario considers the initial seven categories (Proj 1 initial). The second scenario includes the expert opinions related to market trends and production innovation for these seven categories (Proj 2 expert opinion). Finally, the third scenario estimates the production of demersal marine fish without plaice after including the market expert opinions and the split-off from categories (Proj 3 without plaice with expert opinions).



Source: Based on own projection results

Note: Proj 1 Initial: Includes initial baseline projection with the initial seven categories.

Proj 2 Expert Opinion: Includes expert opinions on market trends

Proj 3 Without Plaice with Expert Opinion: Includes expert opinions on market trends and exclude Plaice

Figure 2. Evolution of demersal marine fish production in Germany by 2030 under three scenarios

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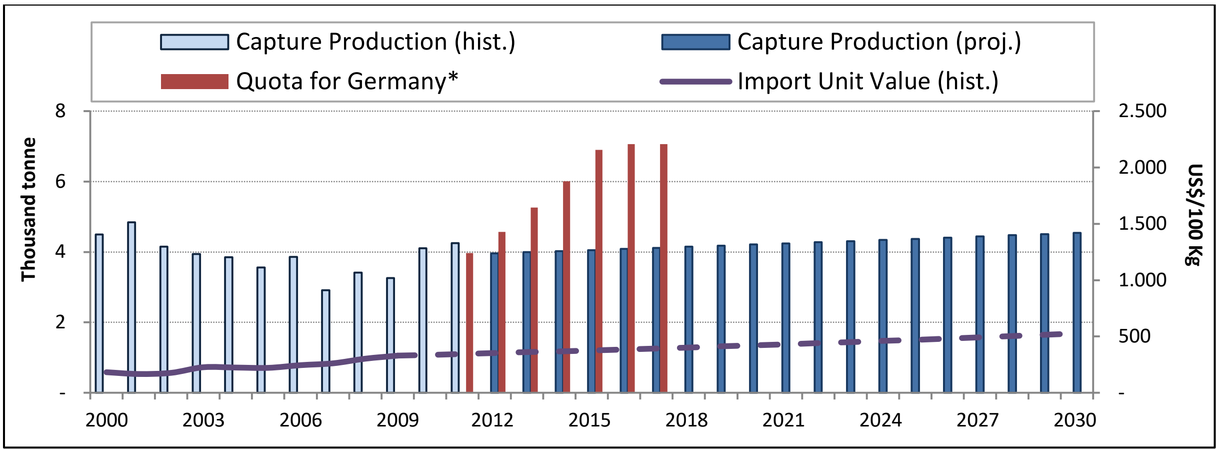
Evaluating demersal marine fish category, production over the years has followed the same trend as group and after excluding Plaice. First results show a subdued increase in demersal production that reaches 76 thousand tonne by 2030. Experts agreed that stocks of demersal fish will recover, total allowable catches (TAC) increase and therefore the capture production would slowly increase over the years. Therefore, the second projection shows a production level of 83.4 thousand tonne by 2030. Under the third projection, the exclusion of plaice reduces the projection level of demersal fish for capture production. However, this reaches the similar levels as under the first baseline projection. Thus, Plaice evolution pushes the growth within demersal capture production. This could be explained by the increasing TAC levels for Plaice in Germany, giving more room to develop.



Source: Based on own projection results

*Quota only for North Sea

Figure 3: Evolution of capture production of plaice „Pleuronectes Platessa" in Germany

5. CONCLUSION

This paper has been concerned with the estimation of the fish market in Germany. Availability of reliable and disaggregated data specific for fish groups appears to be a constant problem. Thus, including expertise knowledge from market experts regarding to expectation of the evolution of the sector provides better and accurate information for market projections. Based on this, this study included three new categories for the baseline projections: Flatfish, Whitefish and Salmonidae. Experts agreed to break up these categories, Flatfish and Whitefish from Demersal fish and Salmonidae from Freshwater fish, due to their significance within the price dynamics. Initial projection reflected a slight increase for Demersal marine fish by 2030. Expectations on recuperation of biological stock of Plaice, as one of the main species of the Demersal group, affect the evolution in the production of Demersal group. With the experts opinion the baseline projections were adjusted, showing a slowly increase over the years, but higher production level by 2030, mainly derived by the increase in Plaice production.

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DOI: http://dx.doi.org/10.18461/pfsd.2017.1710