Paper to be presented at the 20th IIOA Conference, 24-29 June 2012, Bratislava, Slovakia

European Food Security; the Role of Foreign Natural Resources and Imported Intermediate Inputs in European Agriculture

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Abstract

Trade in agricultural and food products, like all trade in goods, has increased over the past decades. However, due to food security concerns, countries have been reluctant to fully liberalize agricultural trade policies. Farmers are still subsidized in order to support domestic production of staples. Retaining some level of self-sufficiency is one motivation for these precautionary policies. Conflicts with countries supplying agricultural or food products may result in trade barriers being erected, cutting consumers and the domestic agricultural production system off from foreign suppliers.

To assess European food security, we study the dependence of European countries on imported intermediate inputs and embodied foreign natural resources in order to meet the current final demand for agricultural and food products. Using data from the EXIOPOL database, we calculate land and water footprints of these products and look at their trade balance to assess whether each country is a net importer or exporter of natural resources. We geographically decompose the footprints to assess whether the countries supplying the embodied land and water can be expected to be stable producers of the agricultural inputs, by determining the local scarcity of land and water.

The next step in capturing the vulnerability of European countries towards international dependency in agricultural production is assessing whether full self-sufficiency would be attainable. We therefore proceed to analyse a scenario in which each country would have to meet final demand of agricultural products and the derived food products itself. We calculate the amount of domestic land and water used in this scenario. Comparing the outcome to projected rainfall and land available, we identify which countries would be more strained in agricultural production. In addition, as agricultural sectors also heavily depend on imports of feed, energy and fertilizers as intermediate inputs in production, we also analyse the demand for these imported inputs in the current situation and in the specified scenario.

Category: Input-output analysis for policy making

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1. Introduction

In the Universal Declaration of Human Rights Article 25 reads "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing…". Although production is adequate to provide every person in the world with a sufficiently nutritional diet, many people still suffer from extreme hunger. The first of the Millennium Goals is to eradicate extreme poverty and hunger, where target 1.C specifically states that the aim is to halve, between 1990 and 2015, the proportion of people that suffer from hunger[1].

Widespread famines do not occur in Europe anymore, but food security is still high on the priority list of European policy makers. Of importance are not so much the world's total productive capacity and the overall scarcity of the necessary resources, but the distributional issues of providing households with food that meets the need for daily intake of required nutrients. Many people in developing countries, and especially infants, still suffer from extreme hunger eventhough total world production of food meets the needs of the total world population.

In our globalized world, international trade has increased tremendously. Countries are more dependent on imports from other countries, but also export more products. In addition, over the last decades production has become increasingly fragmented. Splitting a production chain into multiple stages each located in a different county allows for specialization of each country in the stage of production in which it is most productive. This development has resulted in complex international production networks, with large interdependencies between countries.

The increase in international trade can benefit countries that do not produce certain food staples themselves to obtain these through the international market. However, it may also stimulate the export of food products when more money is earned on the world market than by selling the products to local people. The increasing fragmentation of production increases the vulnerability of country with respect to supply of food, or inputs required to produce food, by trade partners.

In order to obtain more insight in the production system of agricultural and food products, we investigate to which extend agricultural and food sectors depend on intermediate inputs, and to which extend they depend on imported natural resources. We represent the interdependencies and investigate the countries of origin of embodied natural resources to assess whether the supply from these countries is likely to be stable over the years. Finally, we will investigate how much capital, labour, land and water would need to be devoted to agricultural and food production in case a country would have to become fully self-sufficient.

[1] http://www.un.org/millenniumgoals/poverty.shtml, last accessed 18-04-2012

2. Data and methods

In order to investigate the interdependencies among food and agricultural products, the extent to which they import, and their natural resource use, we rely on an environmentally extended international input-output (IIO) table. This table has been constructed as part of the EXIOPOL project. The table consists of 43 individual countries and a 'Rest of the World' (RoW) region. Each country is represented by 129 industries, including 15 agricultural sectors and 11 food sectors. The countries are linked to each other via international trade. The trade flows are represented by bilateral import tables. Bouwmeester and Oosterhaven 2009 discuss the construction of the trade matrices in detail.

The international input-output table is accompanied by a large set of environmental extensions (Lutter et al. 2011). The natural resources we are particularly interested in, in conjunction with agriculture and food production are: land use, water use, and chemical and fertilizer minerals. In this paper we do not investigate the environmental effects of agriculture, for example, CO_2 emissions, nitrogen loads, and phosphor loads.

A one country IO model can be written down as[2]: $\mathbf{x} = \mathbf{A}\,\mathbf{x} + \mathbf{f}$. Solving for $\mathbf{x}$ gives the solution of this system (e.g., Miller and Blair, 2009): $\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\,\mathbf{f} = \mathbf{L}\,\mathbf{f}$. The matrix $(\mathbf{I} - \mathbf{A})^{-1}$ is commonly referred to as the Leontief-inverse, denoted by $\mathbf{L}$. An international model is in essence equal to the one country model. The vector $\mathbf{x}$ and $\mathbf{f}$ then represents output and final demand by industry and by country. The IO model allows to link intermediate inputs through production by industries to final demand.

The indices used in the IIO model are: *i, j* for industries, from 1 to *I*, and *r, s* for countries, from 1 to *R*. The $\mathbf{A}$ matrix has dimensions of *I x R* by *I x R*. In the case of EXIOPOL *I* equals 129 and *R* equals 44. A summation over the index at hand is represented by ●. The table also includes information on value added and final demand categories. The matrices with final demand distinguish between categories of final demand with the index *q* from 1 to *Q*, in addition to distinguishing between country of origin and destination. The model is represented by equation (1).

$$\begin{bmatrix} x_{11}^{11} & \cdots & x_{1Q}^{1R} \\ \vdots & \ddots & \vdots \\ x_{I1}^{R1} & \cdots & x_{IQ}^{RR} \end{bmatrix} = \begin{bmatrix} l_{11}^{11} & \cdots & l_{1I}^{1R} \\ \vdots & \ddots & \vdots \\ l_{I1}^{R1} & \cdots & l_{II}^{RR} \end{bmatrix} \begin{bmatrix} f_{11}^{11} & \cdots & f_{1Q}^{1R} \\ \vdots & \ddots & \vdots \\ f_{I1}^{R1} & \cdots & f_{IQ}^{RR} \end{bmatrix} \qquad \textbf{(1)}$$

[2] In the following text, matrices are denoted by bold capitals letters, vectors by bold lower case letters, and scalars by italicized lower case letters. A prime indicates a transposed matrix or vector. A hat over a vector represents a diagonal matrix, with the values of the vector on the main diagonal. The vector $\mathbf{i}$ is a summation vector with ones, and $\mathbf{I}$ **is** the identity matrix.

The cells of matrix **X** represent the output of industry *i* in country *r* required to satisfy the final demand by category *q* in country *s*.

To retain information on the demand for specific products, the Leontief matrix can be post-multiplied with a diagonal matrix of the final demand vector. This vector can consist of a single final demand vector for one category of final demand in one country, i.e. household final demand in Austria, or it can be an aggregation of several demand vectors, i.e. total final demand in Austria or total household final demand in the EU. Each choice results in a different aggregation level of the most detailed results.

In our analysis, we focus on the final demand by households and governments (represented by index *q*), which we aggregate into a single final demand vector.[3] In assessing the supply of and demand for specific agricultural and food products by individual countries, we diagonalized this final demand vector **f** for each country *s* included in the database. The matrix $\mathbf{X}(\hat{\mathbf{f}}^s)$ shows how much output is generated in each sector and each country, including *s*, due to final demand by *s*.

$$\mathbf{X}(\hat{\mathbf{f}}^s) = \begin{bmatrix} x_{11}^{11} & \cdots & x_{1I}^{1R} \\ \vdots & \ddots & \vdots \\ x_{I1}^{R1} & \cdots & x_{II}^{RR} \end{bmatrix} = \begin{bmatrix} l_{11}^{11} & \cdots & l_{1I}^{1R} \\ \vdots & \ddots & \vdots \\ l_{I1}^{R1} & \cdots & l_{II}^{RR} \end{bmatrix} \begin{bmatrix} f_1^{1s} & \mathbf{0} & 0 \\ \mathbf{0} & \ddots & \mathbf{0} \\ 0 & \mathbf{0} & f_I^{Rs} \end{bmatrix} \tag{2}$$

The environmental extensions are related to the columns of the IIO table. The type of extension is represented by the index *p*. The value of the environmental extensions per industry is given by *e*. By dividing this value by industry output *x* the use intensity is obtained. This coefficient denoted by *d* represents the use of resource *p* per unit of output of the sector at hand. Analogue to Equation (2) we can formulate the following model:

$$\mathbf{E}_p(\hat{\mathbf{f}}^s) = \begin{bmatrix} e_{11}^{1} & \cdots & e_{1I}^{1R} \\ \vdots & \ddots & \vdots \\ e_{I1}^{R1} & \cdots & e_{II}^{RR} \end{bmatrix} = \begin{bmatrix} d_1^1 & \mathbf{0} & 0 \\ \mathbf{0} & \ddots & \mathbf{0} \\ 0 & \mathbf{0} & d_I^R \end{bmatrix} \begin{bmatrix} l_{11}^{11} & \cdots & l_{1I}^{1R} \\ \vdots & \ddots & \vdots \\ l_{I1}^{R1} & \cdots & l_{II}^{RR} \end{bmatrix} \begin{bmatrix} f_1^{1s} & \mathbf{0} & 0 \\ \mathbf{0} & \ddots & \mathbf{0} \\ 0 & \mathbf{0} & f_I^{Rs} \end{bmatrix} \tag{3}$$

Matrix **E** in equation (3) links the cause, i.e. final demand per country, with the use of resource *p*. A cell of matrix **E** shows the resource use *p* due to final demand in country *s* by extracting industry and

[3] We exclude changes in inventories and valuables because it is a resultant vector containing little to no economic data. In addition, the EXIOPOL international IO table includes another resultant vector, which is a discrepancy column arising from the trade-link routine (Bouwmeester and Oosterhaven 2009). This implies that multiplication of the Leontief matrix with our final demand vector, aggregated over the countries where this final demand arises, does not reproduce the total output vector which is part of the international IO table.

country of origin, and by industry and country delivering the final good or service. The dimension of matrix **E** is *I x R* by *I x R*.

3. Demand and supply

In this section we present the link between inputs and final demand[4] for agricultural and food production along various dimensions. From the perspective of a country or a region (i.e. the EU), we first look at final demand for food products and production output of the related industries.

Demand

Final demand for output of industries can be met by production in the country itself, or by importing final goods and services from other countries. Table 1 shows the distribution of EU's final demand for agriculture and food over the countries supplying the final products and services.[5] It basically is a much aggregated representation of the final demand matrix.

The final demand for agriculture products is quite sizeable compared to final demand for food indicating that the sector does not merely produce intermediate inputs. From the perspective of food security it is therefore relevant to include final demand for edible agricultural products into the analysis. The category of 'other' represents all industries not producing edible agricultural products or food products. Of final demand expenditure on all products supplied by EU-high countries 5% is spend on agricultural and food products. For products sourced from EU-low countries, the percentage doubles to 10%

Most products satisfying final demand in the EU are sourced in the EU countries with a high income. When looking at the proportion between agricultural and food products produced by EU high and low countries, it can be seen that production towards EU's final demand for agricultural products is relatively larger in the EU low income countries. From the prentages in the table it is clear that the EU demands most final products from suppliers in the EU.

[4] Note that final demand includes final demand by households and government. Gross fixed capital formation and changes in inventories and valuables are not included. Households and governments demand 94% of agricultural final demand by all categories and 98% of food final demand by all categories.
[5] See Appendix - Table 1 for the products included in these broad categories. See Appendix - Table 2 for the assignment of the 44 EXIOPOL countries to five regions.

Table 1: EU final demand for agriculture, food, and other products
Per region supplying to final demand of households and governments, in 10^9 € and % of total demand (EU and non-EU) by final product suppliers and product group.

final product suppliers	agriculture - edible		food		other	
	10^9 €	%	10^9 €	%	10^9 €	%
EU-high	59	94	323	93	6996	94
EU-low	19	98	46	95	589	96
non-EU-high	1	1	3	0.4	173	1
non-EU-low	3	1	3	1	53	2
RoW	6	6	6	3	71	2

Final demand results in output generation across all countries from which the country imports. This can be through direct imports of final products as shown in Table 1, or through imports of intermediate goods and services used in domestic production for domestic final demand.

In Table 2 we show output generated in all countries included in the EXIOPOL database due to meeting final demand of the EU. Note that this output in principle comprises of the full range of products and services produced to meet final demand for agricultural and food products, as long as these products and services are used in the production of agricultural and food products.

The main producers of output serving to meet final demand in the EU are France, Germany, Italy and the United Kingdom. Spain has a only larger shares for production of inputs used in specific products, like rice, fish and meat products. To satisfy final demand in the EU for agriculture, 85% of output is generated in the EU itself. Sugar cane and suger beet output is only sourced in the EU for 25%. Vegetables, fruits and nuts and fishing each have relatively low percentages of EU sourcing; both are 77%. The average percentage output generated due to final demand for food is even higher. The lowest percentage here is 80% for products not elsewhere classified (nec). It is clear from this table that the EU primarily depends on its own constituents to provide for the inputs necessary to produce food.

With respect to the non-EU countries, only the United States supplies relatively large shares of output towards the production of agriculture and food products. More or less comparable shares are produced by the RoW; which comprises all other countries of the world that are not individually included in the EXIOPOL database.

Table 2: Output generated in EU countries due to EU final demand for specific agricultural goods and services, in percentages (total EU in 10^9 €)

%	AT	BE	BG	CY	CZ	DK	ES	FI	FR	DE	GR	HU	IE	IT	LV	LT	LU	MT	NL	PL	PT	RO	SK	SI	ES	SE	UK	EU	total EU
a_rice	0	0	2	0	0	0	0	0	29	0	15	1	0	9	0	0	0	0	0	0	6	1	0	0	25	0	0	87	2
a_wheat	1	1	0	0	3	1	0	1	16	17	4	1	0	5	0	5	1	0	3	4	2	7	0	0	5	1	13	92	10
a_grains	2	1	0	0	2	1	0	0	3	11	1	1	0	3	0	1	0	0	6	9	3	15	2	1	1	1	30	93	6
a_veg/fruit	1	3	1	0	1	1	0	1	5	9	3	1	1	13	0	0	0	0	6	6	1	1	1	0	9	1	14	77	47
a_oil	4	1	2	0	2	0	0	1	10	2	1	0	0	2	0	1	0	0	1	10	2	0	1	1	1	2	48	93	4
a_sugar	0	0	10	0	3	1	0	0	1	1	0	0	0	1	0	0	4	0	1	0	0	0	0	0	0	0	1	25	0
a_cattle	2	1	0	0	0	1	0	1	32	8	1	0	2	10	0	0	0	0	1	1	2	1	1	0	3	1	21	89	5
a_pigs	2	1	2	0	1	2	0	1	13	13	3	3	1	7	0	0	0	0	1	16	2	2	3	0	5	1	8	85	2
a_poulty	1	3	1	0	1	1	0	1	19	15	3	1	1	6	0	0	0	0	2	9	1	1	1	0	6	1	17	94	28
a_meat	0	0	2	0	0	0	0	0	11	2	6	1	1	5	0	0	0	0	1	1	2	1	0	0	8	0	32	75	0
a_animal	7	0	3	0	0	1	0	1	11	7	2	2	1	6	1	1	0	0	1	9	2	6	2	0	5	1	25	93	6
a_milk	1	1	5	0	1	1	0	0	12	7	4	1	0	4	0	0	0	0	1	15	1	17	1	1	2	1	18	95	12
a_fish	0	1	0	0	0	1	0	1	12	3	5	0	1	13	0	0	0	0	3	1	4	0	0	0	20	1	7	77	11
agri total	1	2	1	0	1	1	0	1	11	10	3	1	1	9	0	1	0	0	4	7	2	4	1	0	8	1	16	85	134
f_cattle	2	3	0	0	1	2	0	1	20	16	2	0	2	12	0	0	0	0	4	2	2	1	0	0	7	2	14	92	85
f_pigs	2	4	1	0	1	3	0	1	13	21	1	1	1	8	0	0	0	0	5	5	1	2	1	0	10	2	6	91	84
f_poulty	1	3	0	0	1	1	0	1	21	10	1	1	1	14	0	0	0	0	5	3	2	1	0	0	9	2	15	93	191
f_meat	1	1	0	1	0	0	0	0	32	5	4	1	3	6	0	0	0	0	4	0	3	2	0	0	6	1	20	91	89
f_oil	1	4	0	0	1	2	0	1	12	22	3	1	0	11	0	0	0	0	4	1	0	1	0	0	10	2	8	86	27
f_diary	2	3	0	0	2	2	0	1	17	22	1	1	2	9	0	1	0	0	6	5	1	1	1	0	6	2	8	93	173
f_rice	0	0	0	0	0	0	0	0	6	15	11	1	0	26	0	0	0	0	2	0	4	1	0	0	19	0	1	85	8
f_sugar	2	6	1	0	2	2	0	1	15	27	2	1	1	9	0	0	0	0	4	3	1	1	1	0	6	3	10	95	32
f_nec	1	4	0	0	1	2	0	1	14	18	2	0	1	10	0	0	0	0	4	1	1	1	0	0	6	2	9	80	101
f_beverages	2	4	0	0	1	1	0	1	13	22	2	0	1	8	0	0	2	0	3	2	1	1	0	0	7	2	12	86	16
f_fish	2	4	0	0	1	2	0	0	6	32	1	0	1	8	0	0	0	0	5	7	1	2	0	0	5	2	10	91	112
food total	1	3	0	0	1	2	0	1	17	18	2	1	1	10	0	0	0	0	5	3	1	1	0	0	7	2	11	90	917
other	2	3	0	0	1	1	0	1	14	19	1	0	1	12	0	0	0	0	4	2	1	0	0	0	6	3	17	90	10318

Table 2 *continued*: Output generated in non-EU countries due to EU final demand for specific agricultural goods and services, in percentages (total non-EU and total World in 10^9 €)

%	AU	BR	CA	CN	IN	ID	JP	MX	NO	RU	ZA	KR	CH	TW	TR	US	RoW	non-EU	total non-EU	total World
a_rice	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	1	1	13	0.3	2
a_wheat	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	2	8	1	11
a_grains	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	2	1	7	1	7
a_veg/fruit	0	0	1	0	0	0	0	0	0	1	1	0	0	0	4	3	11	23	14	60
a_oil	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	1	7	0.3	5
a_sugar	0	6	4	0	0	0	1	0	0	1	0	0	0	0	11	49	2	75	0.00	0.01
a_cattle	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	6	11	1	6
a_pigs	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	8	15	0	3
a_poulty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	6	2	30
a_meat	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	3	15	25	0.1	1
a_animal	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	7	0.4	6
a_milk	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	5	1	13
a_fish	0	0	0	1	0	0	1	0	4	1	0	0	0	0	1	4	11	23	3	14
agri total	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	2	6	15	23	157
f_cattle	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	8	7	92
f_pigs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	9	9	92
f_poulty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	7	15	206
f_meat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	9	9	98
f_oil	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	6	3	14	4	31
f_diary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	7	13	185
f_rice	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	5	6	15	1	9
f_sugar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5	2	33
f_nec	0	1	0	1	0	1	1	0	0	1	0	0	1	0	2	4	6	20	25	126
f_beverages	0	1	1	0	0	0	1	0	1	1	0	0	1	0	1	3	4	14	3	19
f_fish	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	4	9	12	124
food total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	10	99	1015
other	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2	3	10	1112	11429

Supply

In addition to each country's role in demanding agricultural and food products, each country also supplies these products to the world, including its' own domestic market. Table 3 shows the destination of output produced by European countries. The first three columns show the percentages of production supplied to meet final demand in the country itself, the next three columns show the output that is exported only to be reimported at a later stage as final products. The last three columns show the output supplied to final demand by other countries.

Table 3: Average output (weighted) of European countries supplied to own market or abroad

%	own country			own country (abroad)			abroad		
	agri	food	other	agri	food	other	agri	food	other
agri	24	31	13	0.005	0.1	0.1	6	14	10
food	1	57	15	0.0009	0.1	0.1	0.3	17	9
other	0.3	2	72	0.003	0.02	0.2	0.3	2	23

The output of all other industries is used in the production of other final products either domestically demanded our abroad. Of all individual European countries the highest percentage of other output used to satisfy final demand for agriculture and food final products, both at home and abroad is at most 5%.[6] For eight of the 27 EU countries the percentage output of other industries is lower for domestic final demand of other products than foreign final demand of other products. These countries are Belgium, Estonia, Hungary, Ireland, Luxembourg, Malta, Slovak Republic and Slovenia.

Although in terms of international dependence the second group should be distinguished from the first group, the percentage output that is used to meet domestic final demand by supplying inputs to countries that use these to produce final goods and services is very small. As the output exported to serve as inputs for domestic final demand are not 'lost' to the country at hand, in the following table we combine these with output generated for domestic output that does not leave the country in one of its production stages.

Table 4 shows the percentage distribution over the final demand for agriculture, food and other products of output of agriculture and food industries. Seven countries supply more output to foreign countries than to domestic final demand for both sectors; Belgium, Cyprus, Denmark, Estonia, Hungary, Ireland, and the Netherlands. Hungary and Estonia supply more output of the food industry to foreign countries, but not of the agricultural industry.

Agricultural output is more evenly distributed over the final demand groups than output of the food industry. Only 11 of the 27 countries supply most agricultural output to agricultural final demand. Ten of these countries are low income countries; the two exceptions are Luxembourg and the United Kingdom. All other countries supply the largest percentage of output to food production.

[6] Individual country results are not presented in the paper.

Table 4: Destination of output of agriculture and food industries

		final demand of households and government - own country			final demand of households and government - abroad			output
	%	agri	food	other	agri	food	other	10^9 €
Austria	agri	21	29	8	10	12	19	5
	food	0	53	9	0	17	19	11
Belgium	agri	9	21	7	9	33	21	251
	food	0	32	6	1	41	20	6
Bulgaria	agri	44	21	13	9	4	10	24
	food	1	88	5	0	1	4	377
Cyprus	agri	15	24	6	11	19	26	3
	food	0	37	6	1	26	31	2
Czech Rep.	agri	24	42	7	3	13	10	19
	food	1	69	10	0	11	9	1
Denmark	agri	6	16	9	7	40	22	2
	food	0	28	8	1	46	17	14
Estonia	agri	17	27	5	8	27	14	3
	food	0	38	4	1	44	13	7
Finland	agri	22	31	14	4	12	16	94
	food	1	46	16	1	15	21	8
France	agri	17	40	9	6	16	12	15
	food	1	66	8	0	15	10	201
Germany	agri	22	41	12	4	12	9	0.3
	food	0	69	10	0	13	8	1
Greece	agri	39	31	7	6	6	11	9
	food	0	67	11	0	8	14	4
Hungary	agri	19	21	8	9	25	18	7
	food	1	37	6	1	39	16	166
Ireland	agri	10	11	6	5	42	27	50
	food	0	19	5	1	48	26	110
Italy	agri	18	30	23	5	9	16	1818
	food	0	51	22	0	11	15	36
Latvia	agri	37	14	17	10	14	9	122
	food	2	36	21	1	29	12	2523
Lithuania	agri	55	22	4	9	6	4	9
	food	0	76	4	0	14	6	13
Luxembourg	agri	36	0	20	3	14	27	151
	food	0	56	17	0	12	14	4
Malta	agri	52	26	4	3	4	10	5
	food	2	69	4	0	12	13	62
Netherlands	agri	4	12	6	22	38	18	6
	food	0	24	6	1	50	18	12
Poland	agri	49	31	10	0	5	5	131
	food	2	72	12	0	8	7	38
Portugal	agri	30	39	19	2	5	5	89
	food	1	67	20	0	7	5	1589
Romania	agri	61	28	4	1	2	4	0.5
	food	1	85	8	0	2	4	1
Slovak Rep.	agri	45	28	9	4	6	8	9
	food	2	71	6	1	12	8	1
Slovenia	agri	34	21	16	4	5	20	2
	food	1	45	16	1	16	21	15
Spain	agri	13	29	24	12	13	9	0.2
	food	1	53	27	0	13	7	0.5
Sweden	agri	15	37	17	4	10	16	41
	food	0	61	13	0	11	15	0.2
UK	agri	53	21	16	2	5	4	0.3
	food	1	57	29	0	8	6	6

Food products are mainly destined for final demand of food products, in particular for the domestic market. However, a sizeable amount is also used in production of other final demand. The countries that supply more output to foreign final demand, export specifically food output in order to satisfy demand for food products.

4. Resources used in agriculture and food production

To be written.

5. Self-sufficiency in extreme: autarky

To be written.

6. Conclusion and further work

To be written.

A next step in the analysis is to assess the importance of particular cells in the **A** matrix with respect to agriculture and food production. We plan to use the notion of fields of influence to investigate which cells, representing a four dimensional value (country *x* industry by country *x* industry) can be identified as main contributors to output generation.

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Appendix 1 - Sectors of interest and alternative aggregation

The three sector aggregation represents the three main sectors of interest: agriculture, food and other. The detailed sector representation includes all original detail on the agricultural sectors that mainly provide staples and all food sectors, as available in the EXIOPOL database.

Appendix - Table 1: sector detail

a	i01.a	Cultivation of paddy rice	a_rice
a	i01.b	Cultivation of wheat	a_wheat
a	i01.c	Cultivation of cereal grains nec	a_grains
a	i01.d	Cultivation of vegetables, fruit, nuts	a_veg/fruit
a	i01.e	Cultivation of oil seeds	a_oil
a	i01.f	Cultivation of sugar cane, sugar beet	a_sugar
a	i01.i	Cattle farming	a_cattle
a	i01.j	Pigs farming	a_pigs
a	i01.k	Poultry farming	a_poulty
a	i01.l	Meat animals nec	a_meat
a	i01.m	Animal products nec	a_animal
a	i01.n	Raw milk	a_milk
a	i05	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing (05)	a_fish
f	i15.a	Processing of meat cattle	f_cattle
f	i15.b	Processing of meat pigs	f_pigs
f	i15.c	Processing of meat poultry	f_poulty
f	i15.d	Production of meat products nec	f_meat
f	i15.e	Processing vegetable oils and fats	f_oil
f	i15.f	Processing of dairy products	f_diary
f	i15.g	Processed rice	f_rice
f	i15.h	Sugar refining	f_sugar
f	i15.i	Processing of Food products nec	f_nec
f	i15.j	Manufacture of beverages	f_beverages
f	i15.k	Manufacture of fish products	f_fish
o	o	All other*	other

*Note that 'All other' includes:

i01.g	Cultivation of plant-based fibers
i01.h	Cultivation of crops nec
i01.o	Wool, silk-worm cocoons
i02	Forestry, logging and related service activities (02)
and	i10, i11, i12, i13, i14, i16 up to i99

Appendix 2 – Country lists and abbreviations

Appendix - Table 2

EU-high		PPP $ 2000*
LU	Luxembourg	53652
NL	Netherlands	29403
DK	Denmark	28829
AT	Austria	28773
IE	Ireland	28639
SE	Sweden	27961
BE	Belgium	27612
UK	United Kingdom	26072
DE	Germany	25945
FI	Finland	25653
IT	Italy	25595
FR	France	25328
ES	Spain	21323

EU-low		PPP $ 2000*
CY	Cyprus	19412
GR	Greece	18412
MT	Malta	18291
PT	Portugal	17751
SI	Slovenia	17474
CZ	Czech Republic	14993
HU	Hungary	12266
SK	Slovak Republic	10997
PO	Poland	10514
EE	Estonia	9882
LT	Lithuania	8602
LV	Latvia	8031
BG	Bulgaria	6301
RO	Romania	5654

non-EU-high		PPP $ 2000*
NO	Norway	36130
US	United States	35081
CH	Switzerland	31731
CA	Canada	28407
AU	Australia	26422
JP	Japan	25619
TW	Taiwan	19866
KR	South Korea	17219

non-EU-low		PPP $ 2000*
MX	Mexico	9201
TR	Turkey	8867
BR	Brazil	7021
RU	Russian Federation	6824
ZA	South Africa	6773
ID	Indonesia	2417
CN	China	2364
IN	India	1574

** GDP per capita, in PPP (current international $) for 2000. World Development Indicators, http://data.worldbank.org/indicator, accessed 16-5-2012. Source: World Bank national accounts data, and OECD National Accounts data files.*