REPORT

Report on organic protein availability and demand in Europe



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Supported by

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1. Abbreviations and definitions

Area EF: Estimated area for feed

CP: Crude protein

CYS: Cysteine

DE: Digestible Energy

DM: Dry matter

FP: Feeding purpose

Ha: Hectares

Kg: Kilograms

LSU: Livestock Unit

LYS: Lysine

ME: Metabolizable Energy

MET: Methionine

MJ: Mega joule

mt: Metric tons

N: Nitrogen

Production EF: Estimated production of feed

Definitions

Concentrate feed: Mix of cereals, oilseeds, and dried pulses used for feeding.

Monogastrics: In this report the term monogastrics refers to pigs, broilers and laying hens.

2. Summary

2.1 About

The aim of this study, carried out as part of work package 1 of the project Improved Contribution of Local Feed to Support 100% Organic Feed Supply to Pigs and Poultry (ICOPP), was to assess feed availability and demand throughout the countries of the ICOPP project and Europe. The ICOPP project is funded by national funding bodies that are part of the CORE Organic II project (Coordination of European Transnational Research in Organic Food and Farming Systems, www.coreorganic2.org). Partners from the following ten European countries were part of the project: Austria, Denmark, Finland, France, Germany, Lithuania, the Netherlands, Sweden, Switzerland and the United Kingdom. All partners provided information from their country on feed production, livestock numbers and feeding strategies. The Research Institute of Organic Agriculture (FiBL), the Swiss project partner, conducted the survey and made the calculations on the supply and demand of concentrate feed, crude protein as well as essential amino acids from certified organic origin. Consequently, the self-sufficiency regarding organic feed for monogastrics was calculated for each of the countries participating in the project.

In order to carry out the necessary work,

- a desk study was performed (compilation of existing data, literature review),
- a survey among the ICOPP partners was conducted (design of the questionnaire, data collection among partners),
- the demand and supply of concentrate feed, crude protein and essential amino acids was calculated in detail for the ICOPP countries, based on information from the partners and additional sources;
- the importance of the ICOPP countries for European organic production was evaluated;
- an extrapolation to Europe was made for the demand and supply of concentrate feed and crude protein for feeding organic monogastric animals;
- an estimation was made about the possibility to satisfy the demand for organic feed with European production.

2.2 Methods

Desk study and survey

Baseline data on organic **crop production** were extracted from the database on organic agriculture of the Research Institute of Organic Agriculture (FiBL), which includes annually updated land-use data on organic agriculture in Europe, based on information from Eurostat and national sources. In addition the project partners were asked to supply further details on feed crops such as the area and production of crops grown for feed (this distinction is usually not made in the national statistics, this also applies to export and import statistics).

Furthermore, baseline data on organic **livestock numbers** were extracted from the FiBL database. In addition, the project partners were asked to supply further details on livestock numbers and further indicators such as the fattening period, average weight at slaughter or the average duration of laying period.

For the survey, a questionnaire was created, and the partners provided the data based on interviews with national organic sector bodies, selected stakeholders, and experts (feed mills, national authorisation bodies, scientists). The survey among the project partners was complemented by a literature survey.

Calculation of feed supply and demand

For the calculation of the feed supply/protein availability and demand, the following steps were taken:

- Availability: The total estimated feed volume in metric tons (mt) was provided by the project partners. This was used to calculate the available quantities of total dry matter (in kilograms), energy (mega joule), crude protein (in kilograms) and of the essential amino acids lysine, methionine and methionine + cysteine (in kilograms). For the calculation, the Swiss Agroscope feed database was used (University of Zürich and Agroscope, 2014).
- For the calculation of the required amounts of concentrate feed, crude protein and essential amino acids, animal numbers were used as provided by the ICOPP partners. An average concentrate feed, crude protein and amino acid demand per single unit (e.g. “one fattening pig”) was set, based on a number of sources. For certain units these demands had to be adjusted based on the countries’ feeding practices. In order to calculate the demand, the number of animals was multiplied by the average feed requirements mentioned above.

2.3 Results

The self-sufficiency rate for concentrate feed for each ICOPP country was calculated as a percentage of the concentrate feed actually produced compared with the total demand for concentrate feed. A self-sufficiency rate of 69 percent for concentrate feed for the ten ICOPP countries was calculated. Over 50 percent of the total demand (1’923’000 metric tons) for concentrate feed was fed to bovine animals, 16 percent was fed to pigs and 30 percent to poultry.

The self-sufficiency rate for crude protein was calculated for each ICOPP country as a percentage of the actual produced crude protein, relative to the total demand for crude protein. A self-sufficiency rate for crude protein of 56 percent over all ICOPP countries was calculated. It is obvious that, except for Lithuania, organic crude protein demand clearly exceeds availability, and an overall gap of approximately 135’000 metric tons of crude protein exists within the ICOPP countries. The demand for crude protein was more than 300’000 metric tons. Seventeen percent was fed to pigs, 34 percent to poultry and 49 percent to bovine animals.

Based on (a) the calculations of the concentrate feed production and its crude protein and essential amino acid content and (b) the calculations of the demand of the animal categories, it could be shown that the supply gap with respect to essential amino acids is higher than the supply gap for crude protein. The total self-sufficiency of the ICOPP countries is just above 50 percent for lysine, about 40 percent for methionine and about 55 percent for methionine+cysteine.

While the data calculated for the ICOPP countries seem to be very close to reality because of the detailed data collection as part of the ICOPP project, the extrapolation to Europe is a rough estimation because of the lack of reliable data. There are few data on feed production in the countries, and there are no data on feed imports and exports. The extrapolation shows that there is still a gap of an estimated 30 percent for crude protein in Europe, even if the countries whose production of feed exceeds their own requirements from livestock will export 80 percent of their produced protein crops (including soya and other oilseeds) to the countries with feed imports in Europe.

2.4 Conclusions

The following conclusions can be drawn based on the results of the ICOPP study on protein supply and demand in Europe:

- According to the data provided, it seems quite unrealistic that the ICOPP countries will be able to cover the organic protein demand through their own efforts and increase production in the foreseeable future.
- A large proportion of concentrate feed is fed to ruminants. If a part of the concentrate feed for ruminants (1'050'000 metric tons) was used for feeding non-ruminant animals, a great step forward could be made.
- In order to meet the essential amino acid requirements for the individual animal categories, the types of protein crops which could be produced organically in a country are relevant. The climatic conditions are a determining factor. The area of arable land available for producing high-protein crops such as soybeans, for example, is less in the northern parts of Europe and overall Europe, compared with the Southern hemisphere and China. Therefore, other solutions must be found. There are different feeding possibilities, which were researched in the ICOPP and other research projects, but there is still a need for more innovative solutions.
- The European Commission is envisaging a stricter organic regulation for feed with a higher proportion of feed produced on-farm/in the region. However, the results of our calculations have shown that this might be difficult to achieve for some countries.
- Considering that there is a protein gap in organic farming, for the organic sector, an emphasis must be placed on making a certain justifiable amount of imports acceptable.
- Data on organic livestock and the market for livestock products is still scarce. There is a clear need for more and better data and for permanent and reliable data collection efforts in this field.

3. Organic agriculture in Europe – current status with a focus on feed crops and livestock numbers

3.1 Introduction

The following section, which is part of the desk study carried out in the ICOPP project, includes background information on the current situation of organic farming in the European Union and Europe. Furthermore, overall livestock numbers for pigs, poultry and bovine animals and of organic production areas for protein feed - cereals, oilseeds (including soybeans) and dried pulses[1] - are presented. Even though the calculations of protein supply and demand in the ICOPP countries are based on the 2011 data, we are presenting the 2012 data in this particular chapter, as these were available at the time of writing.

3.2 Data sources

The data presented in this chapter are based on the surveys of the Research Institute of Organic Agriculture FiBL and the Agricultural Marketing Information Company AMI, Germany, carried out by the two institutions over the past decade and for the 2011 and 2012 data in the framework of the EU-funded OrganicDataNetwork project (Willer and Schaack 2014).[2] A large part of the area and livestock data are based on Eurostat data (Eurostat 2014), but national data sources and a recent publication of the European Commission were also used (European Commission 2014). For the comparison with the overall total, FAOSTAT data was used (FAOSTAT 2014) as it covers the whole of Europe and not just the European Union.

3.3 Current situation of organic farming in Europe

In 2012, the area of organic land, the number of organic farmers and the organic market continued to grow in Europe. In Europe, 11.1 million hectares (EU: 10 million hectares) were under organic management, an increase of six percent compared with 2011. The country with the largest organic agricultural area is Spain (1.6 million hectares), followed by Italy (1.2 million hectares), Germany and France (both slightly over 1 million hectares). There were more than 320'000 producers (EU: more than 250'000). The value of the European organic market in 2012 was 22.8 billion euros (EU: 20.9), and the overall growth rate compared with 2011 was approximately six percent (Willer et al. 2014).

[1] According to the Eurostat questionnaire for organic farming (Data collection on organic farming statistics, Final Harmonised Questionnaire, unpublished), "dried pulses and protein crops for the production of grain (including seed and mixtures of cereals and pulses)" are:

"Crops sown and harvested mainly for their protein content. This heading includes the areas of peas (Pisum sativum L.), field beans (Vicia faba L.) and sweet lupins (Lupinus spp.), sown in pure crops, harvested dry for grain but also the areas of other crops harvested dry for grain, mainly for their protein content as for example dried beans (Phaseolus vulgaris L. and P. coccineus), other dried peas (Pisum arvense,), lentils (Lens culinaris Medikus (syn.esculenta, syn. Ervum lens and Lens orientalis, L.), chickling vetch (Lathyrus cicera L.), chick peas (Cicer arietinum), vetches (Vicia sativa L, Vicia pannonica Crants or Vicia varia) and other protein crops sown in pure crops, harvested dry for grain. Protein crops harvested green shall not be included here."

In the Eurostat organic farming database at http://ec.europa.eu/eurostat/web/organic-farming/database, this group is referred to as "dried pulses."

[2] Chapter 3 was written by Helga Willer of the Research Institute of Organic Agriculture (FiBL), and some of the work is based on the data collected in the framework of the OrganicDataNetwork project. The author gratefully acknowledges financial support from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no 289376 ("Data network for better European organic market information" - OrganicDataNetwork).

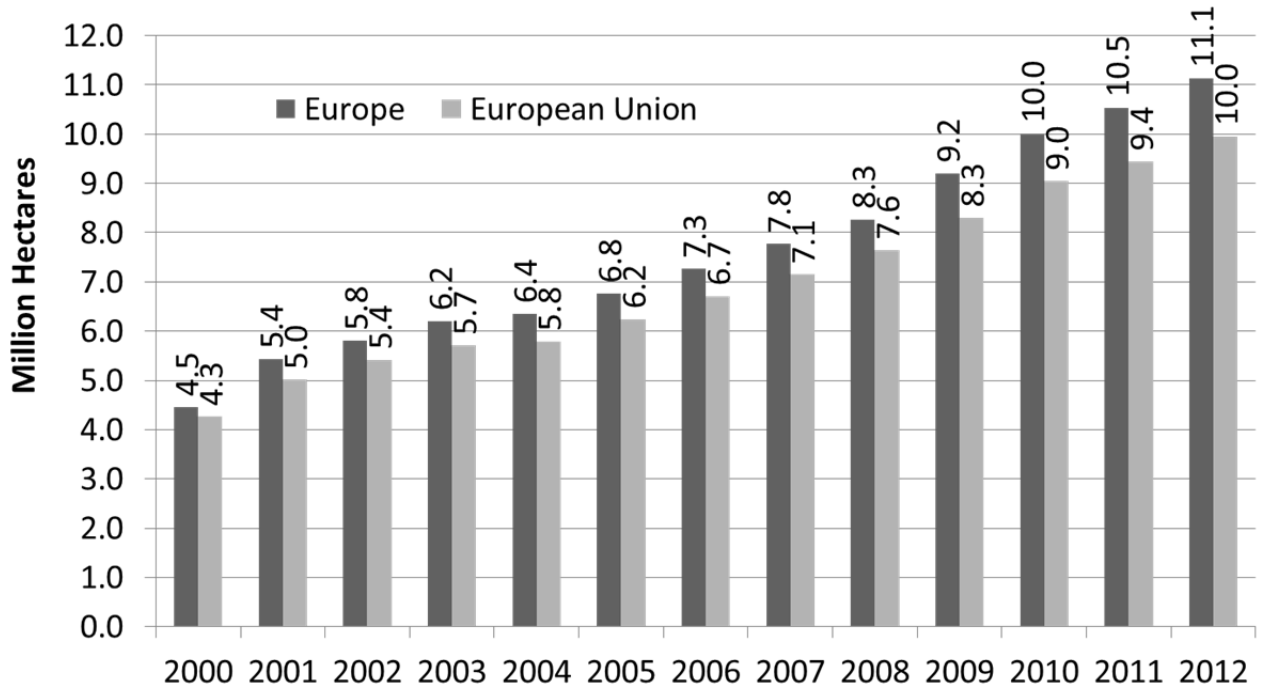

Figure 1: Europe and European Union: Development of organic agricultural land 2000-2012

Source: Lampkin, Nic and FiBL-AMI-OrganicDataNetwork based on national data sources and Eurostat.

3.4 Land use and feed crops grown in Europe

3.4.1 Land use

In Europe, in 2012, 42 percent (EU 39 percent) of the organic farmland was used for arable crops (4.7 million hectares; EU: 3.9 million hectares), and 44 percent (EU 47 percent) was grassland/grazing areas (4.9 million hectares, EU: 4.7 million hectares), with ten percent (1.1 million hectares, EU: 1 million) being used to grow permanent crops.

Regarding permanent grassland/grazing land, which increased by three percent from 2012, the countries with the largest areas were Spain (0.85 million hectares), Germany (0.58 million hectares) and the United Kingdom (0.41 million hectares). To convert extensively used areas and grassland to organic farming requires relatively few changes in production and few investments. Land use shows considerable variation between the member states of the European Union and Switzerland. The western and mountainous regions have a very high proportion of area under organic grassland as shown in Figure 2 and Figure 3.

The largest **arable crop areas**, which increased by seven percent over those in 2011, were in Italy (0.53 million hectares), France (0.52 million hectares), and Germany (0.43 million hectares). The key arable crop group after green fodder from arable land (almost 2 million hectares) was cereals; forty percent of the arable land is for cereal production, amounting to 1.9 million hectares in total: an increase of six percent over the 2011 figures. The largest cereal areas are in Italy (more than 210'000), Germany (202'000 hectares), Turkey (198'000 hectares), and Spain (174'000 hectares). Organic vegetables were grown on 116'000 hectares in 2012, with Italy (21'000 hectares), France (13'600 hectares), the United Kingdom (10'700 hectares), and Germany (10'600 hectares) as the key producing countries.

Ten percent of the organic farmland was used **for permanent crops**, and the permanent crop area increased by four percent over that in 2011. The countries with the largest permanent crop areas

are Spain (360’000 hectares), Italy (306’000 hectares) and France (89’000 hectares). Compared with that in 2011, a large part of the permanent cropland was used for olives (460’000 hectares; +9 percent), grapes (241’000 hectares; +4.5 percent), and nuts (172’000 hectares; -7 percent).

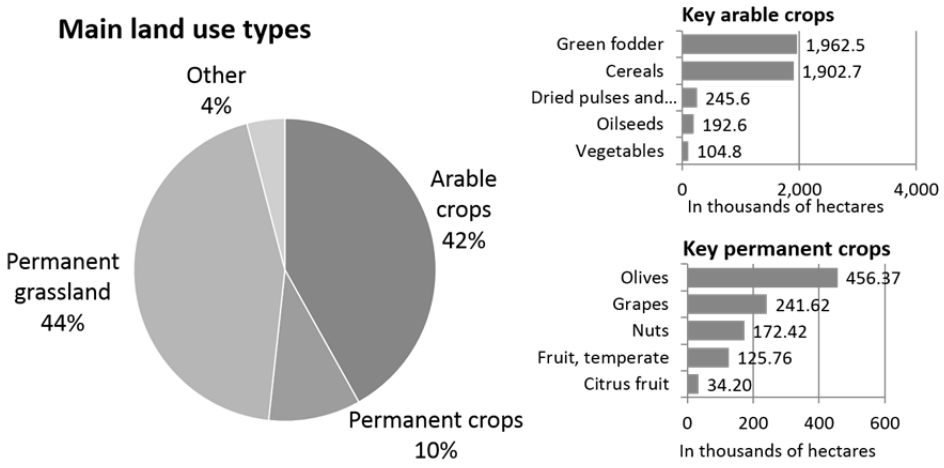

Figure 2: Europe: Use of agricultural land and key crop groups 2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on Eurostat and national data sources (Willer et al. 2014, updated)

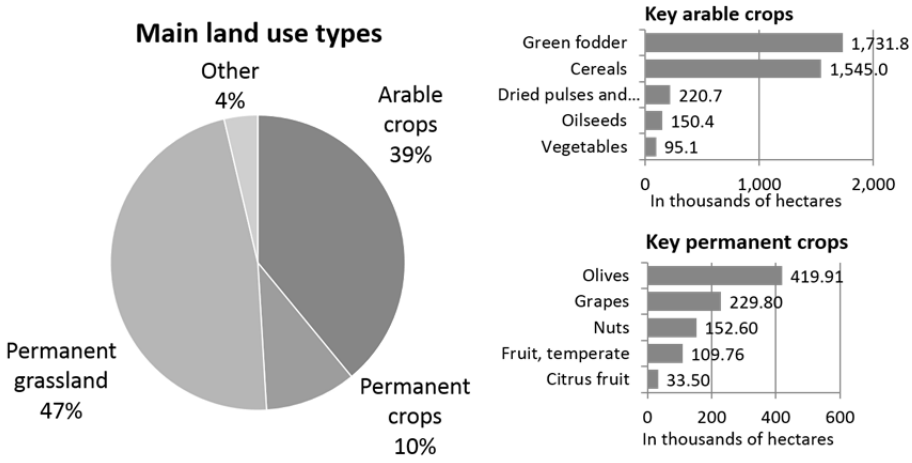

Figure 3: European Union: Use of agricultural land and key crop groups 2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on Eurostat and national data sources (Willer et al. 2014, updated)

3.5 Main crops that are relevant for feed production

3.5.1 Area for cereals, dried pulses and oilseeds

The crops that are most relevant for organic protein feed production are cereals, oilseeds and dried pulses. It may be assumed that a major part of the cereals is used for human consumption, and that the majority of the oilseeds and dried pulses grown are used for animal feed, with the rest used for seed and human consumption. It may also be assumed that much of the production coming from the conversion area is destined for production of feedstuffs.

- Official organic farming statistics do not show the end use of the crop. As this chapter is about all of Europe, it is not possible to make the distinction between crops grown for human consumption and animal feed as it was done with the countries analysed in detail as part of the ICOPP project and as shown in the following chapter.
- Therefore, the data presented here cover *all* cereals, oilseeds and dried pulses grown in Europe/the European Union.

In Europe and the European Union, the cereal, dried pulses, and oilseeds area constituted about one fifth of the organic agricultural land and about half the organic arable land.

Table 2 shows the land areas of organic cereals, dried pulses, and oilseeds in 2012 when a total of 2.3 million hectares were cropped with these crops in Europe (European Union: 1.9 million hectares). Of all European countries, Italy has the largest cereal, dried pulses and oilseed area with 240'000 hectares, followed by Germany and Spain (230'000 hectares).

The highest shares of the overall area for these crops were reached in Austria (12.7 percent), Sweden (8.8 percent), and Estonia (7.2 percent).

Strong growth since 2007 was noted for all three crop groups, but particular growth was noted for the dried pulses, the area of which has more than doubled. It should be noted that growth for these crops was higher in the new member states, i.e. countries that became a member of the European Union (EU) after 2004, than in the old member states. All three crop groups have shown a stronger growth than the total organic agricultural land in the same time period.

Table 1: Development of organic cereal, dried pulses, and oilseed areas in Europe and the European Union 2007-2012

	Europe			European Union		
Crop group	**Organic area (Hectares)**	**Organic share %**	**Growth 2007-2012**	**Organic area**	**Organic share %**	**Growth 2007-2012 in percent**
Cereals	1'902'703	1.5 %	+43.6 %	1'544'971	2.7 %	+ 30.8 %
Dried pulses	245'640	6.0 %	+142.1 %	220'653	15.3 %	+ 144.5 %
Oilseeds	192'591	0.6%	+78.1 %	150'376	1.3 %	+ 69.2 %
Total	2'340'934	1.4 %	+52.5 %	1'916'000	2.7 %	+ 40.8 %

Source: OrganicDataNetwork survey 2013, FiBL-AMI survey 2014 based on national data sources and Eurostat (Willer et al. 2014, updated)

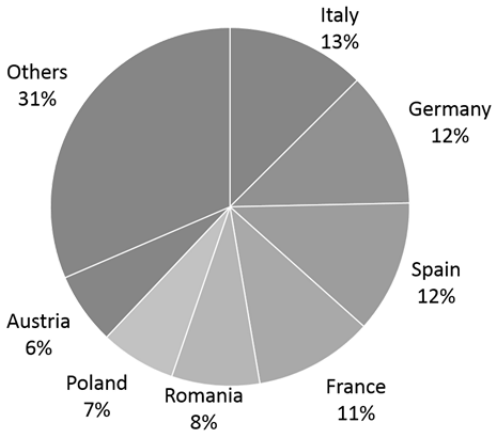

Figure 4: Breakdown of land area (hectares) for organic cereals, dried pulses and oilseeds by country 2012

Source: OrganicDataNetwork survey 2014, and FiBL-AMI survey 2014 based on national data sources and Eurostat (Willer et al. 2014, updated)

Table 2: Organic area of cereals, oilseeds dried pulses, share of total area for the countries of Europe 2012

Country	Crop group	Organic area (hectares)	Organic share %
Albania	Cereals	No Data	0.0
	Dried pulses	No Data	0.0
	Oilseeds	No Data	0.0
Albania total		*No Data*	*0.0*
Austria	Cereals	97'178	12.0
	Dried pulses	12'459	58.6
	Oilseeds	14'586	9.8
Austria total		*124'223*	*12.7*
Belarus	Cereals	No Data	0.0
	Dried pulses	No Data	0.0
	Oilseeds	No Data	0.0
Belarus total		*No Data*	*0.0*
Belgium	Cereals	4'265	1.3
	Dried pulses	2'599	162.6
	Oilseeds	68	0.3
Belgium total		*6'932*	*2.0*
Bosnia and Herzegovina	Cereals	45	0.0
	Dried pulses	No Data	0.0
	Oilseeds	2	0.0
Bosnia and Herzegovina total		*47*	*0.0*
Bulgaria	Cereals	7'532	0.4
	Dried pulses	48	0.9
	Oilseeds	3'292	0.3
Bulgaria total		*10'873*	*0.4*
Croatia	Cereals	7'261	1.3
	Dried pulses	23	1.4
	Oilseeds	2'074	1.9
Croatia total		*9'358*	*1.4*
Cyprus	Cereals	752	2.0
	Dried pulses	No Data	0.0
	Oilseeds	No Data	0.0
Cyprus total		*752*	*1.9*
Czech Republic	Cereals	27'444	1.9
	Dried pulses	2'369	9.9
	Oilseeds	1'986	0.4
Czech Republic total		*31'799*	*1.6*
Denmark	Cereals	56'239	3.8
	Dried pulses	3'046	39.1
	Oilseeds	304	0.2
Denmark total		*59'589*	*3.6*
Estonia	Cereals	23'626	8.0
	Dried pulses	1'917	22.4
	Oilseeds	3'064	3.4
Estonia total		*28'607*	*7.2*
Finland	Cereals	40'535	3.8
	Dried pulses	9'001	62.1
	Oilseeds	2'342	2.6
Finland total		*51'878*	*4.5*
France	Cereals	133'195	1.4
	Dried pulses	45'069	15.0
	Oilseeds	27'098	1.1
France total		*205'362*	*1.7*
Germany	Cereals	202'000	3.1
	Dried pulses	22'200	22.5
	Oilseeds	8'200	0.6
Germany total		*232'400*	*2.9*
Greece	Cereals	51'544	5.4
	Dried pulses	3'727	24.3
	Oilseeds	1'948	2.9
Greece total		*57'219*	*5.5*
Hungary	Cereals	27'029	1.0
	Dried pulses	2'417	12.5
	Oilseeds	8'467	1.0
Hungary total		*37'913*	*1.1*
Ireland	Cereals	No Data	0.0
	Dried pulses	No Data	0.0
	Oilseeds	No Data	0.0
Ireland total		*No Data*	*0.0*
Italy	Cereals	210'543	6.1
	Dried pulses	20'837	29.6
	Oilseeds	8'760	2.9
Italy total		*240'141*	*6.3*
Latvia	Cereals	30'771	5.9
	Dried pulses	3'299	
	Oilseeds	877	0.7
Latvia total		*34'947*	*5.4*
Liechtenstein	Cereals	62	No Data
Liechtenstein total		*62*	*No Data*
Lithuania	Cereals	66'923	6.3
	Dried pulses	26'486	61.0
	Oilseeds	5'513	2.1
Lithuania total		*98'922*	*7.2*
Luxembourg	Cereals	633	2.2
	Dried pulses	74	23.7
	Oilseeds	4	0.1
Luxembourg total		*711*	*2.1*
Malta	Cereals	0	0.0
	Dried pulses	No Data	0.0
Malta total		*0*	*0.0*

Country	Crop group	Organic area (hectares)	Organic share %
Moldova	Cereals	8'399	No Data
	Dried pulses	4'641	No Data
Moldova total		*13'040*	*No Data*
Montenegro	Cereals	No Data	0.0
	Dried pulses	No Data	0.0
Montenegro total		*No Data*	*0.0*
Netherlands	Cereals	4'075	2.0
	Dried pulses	83	3.6
	Oilseeds	33	0.7
Netherlands total		*4'191*	*2.0*
Norway	Cereals	8'844	3.0
	Dried pulses	161	7.3
	Oilseeds	34	0.7
Norway total		*9'039*	*3.0*
Poland	Cereals	122'818	1.6
	Dried pulses	5'698	3.7
	Oilseeds	1'573	0.2
Poland total		*130'089*	*1.5*
Portugal	Cereals	No Data	0.0
	Dried pulses	No Data	0.0
	Oilseeds	No Data	0.0
Portugal total		*No Data*	*0.0*
Romania	Cereals	105'148	2.0
	Dried pulses	2'764	5.2
	Oilseeds	43'923	3.0
Romania total		*151'835*	*2.3*
Russian Federation	Cereals	3'304	0.0
	Dried pulses	457	0.0
	Oilseeds	985	0.0
Russian Federation total		*4'746*	*0.0*
Serbia	Cereals	2'522	0.1
	Dried pulses	No Data	0.0
	Oilseeds	No Data	0.0
Serbia total		*2'522*	*0.1*
Slovakia	Cereals	15'406	2.1
	Dried pulses	246	3.0
	Oilseeds	2'533	1.0
Slovakia total		*18'185*	*1.8*
Slovenia	Cereals	1'386	1.4
	Dried pulses	No Data	0.0
	Oilseeds	249	4.7
Slovenia total		*1'635*	*1.6*
Spain	Cereals	174'005	2.9
	Dried pulses	45'195	12.6
	Oilseeds	9'820	1.1
Spain total		*229'020*	*3.2*
Sweden	Cereals	86'538	8.8
	Dried pulses	9'761	30.0
	Oilseeds	3'395	3.0
Sweden total		99'694	8.8
Switzerland	Cereals	6'690	4.6
	Dried pulses	453	11.7
	Oilseeds	351	1.3
Switzerland total		*7'494*	*4.3*
The former Yugoslav Republic of Macedonia	Cereals	2'255	1.4
	Dried pulses	No Data	0.0
	Oilseeds	159	2.0
The former Yugoslav Republic of Macedonia total		*2'414*	*1.3*
Turkey	Cereals	197'877	1.7
	Dried pulses	9'355	1.2
	Oilseeds	2'154	0.3
Turkey total		*209'386*	*1.6*
Ukraine	Cereals	127'733	0.9
	Dried pulses	9'920	3.2
	Oilseeds	38'530	0.6
Ukraine total		*176'183*	*0.8*
United Kingdom	Cereals	48'123	1.6
	Dried pulses	1'335	0.8
	Oilseeds	268	0.0
United Kingdom total		*49'726*	*1.2*
Total Europe		2'340'934	1.4
Total European Union		1'916'000	2.7

Source: OrganicDataNetwork survey 2014, FiBL-AMI survey 2014 based on national data sources and Eurostat (Willer et al. 2014, updated)

3.5.2 Cereals

In 2012, the organic cereal area in Europe was 1.9 million hectares or 1.5 percent of all cereals and constituted about 17 percent of the total organic agricultural land and almost 41 percent of the organic arable land. In the European Union, organic cereals were grown on almost 1.55 million hectares or 2.7 percent of the agricultural land, representing 15.5 percent of the total organic agricultural land and almost 40 percent of the organic arable land.

Of all European countries, Italy has the largest cereal area with 210’543 hectares, followed by Germany (202’000 hectares) and Turkey (197’877 hectares).

The highest shares of the overall organic cereal area were reached in Austria (12 percent), Sweden (8.8 percent) and Estonia (8 percent).

Since 2007, the organic cereal area has shown a growth of almost 500’000 hectares and of 20 percent in the European Union; and of more than 40 percent in the whole of Europe (Figure 5), thus corresponding to the growth of the total organic agricultural land. In the new member states of the European Union (the countries that became an EU member after 2014) the area has increased faster; by 18 percent from 2011 to 2012 (by 9 percent in the old member states).

The most important cereals were wheat (752’720 hectares), followed by barley (288’779 hectares), and oats (263’327 hectares)

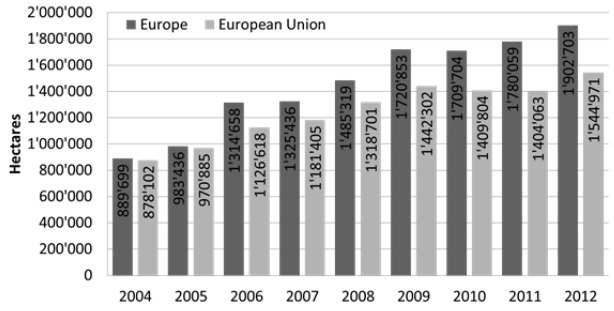

Figure 5: Organic cereals: Development in the European Union and Europe 2004-2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat (Willer et al. 2014, updated)

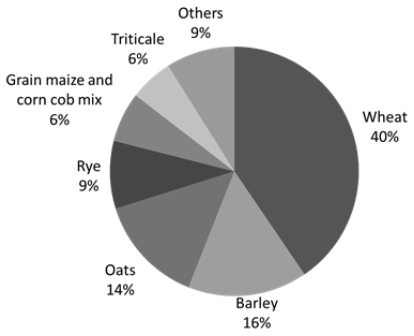

Figure 6: Organic cereals in Europe: Breakdown by crop 2012 (total: 1.9 million hectares)

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat (Willer et al. 2014, updated)

3.5.3 Oilseeds

In 2012, the organic oilseed area in Europe was 192’591 hectares constituting 0.6 percent of all oilseeds grown. Oilseeds represented almost 2 percent of the total organic agricultural land and about 4 percent of the organic arable land. In the European Union organic oilseeds were grown in more than 150’000 hectares, representing 1.5 percent of the total organic agricultural land and almost 4 percent of the arable land.

Of all European countries, Romania has the largest oilseeds area with 43’923 hectares, followed by Ukraine (38’530 hectares) and France (27’098 hectares).

The highest shares of the overall organic oilseeds area were reached in Austria (9.8 percent), Slovenia (4.7 percent) and Estonia (3.4 percent).

Since 2007, the organic oilseed area has shown a growth of almost 100’000 hectares or 78 percent in Europe and 69 percent in the European Union, thus exceeding the growth of total organic agricultural land. In the new member states of the European Union (the countries that became an EU member after 2004) the area has increased faster; by 4 percent from 2011 to 2012 (and decreased by 1 percent in the old member states).

The most important oilseeds were sunflower seed (61’963 hectares), followed by rape and turnip rape (37’832 hectares) and soybeans (28’477 hectares).

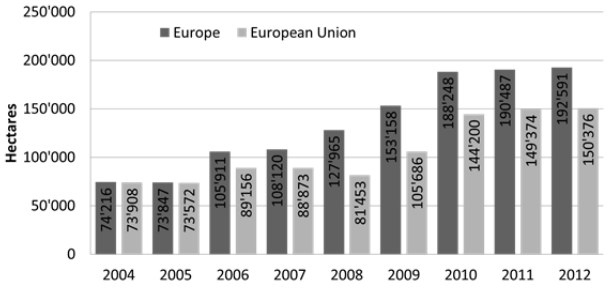

Figure 7: Organic oilseeds: Development in the European Union and Europe 2004-2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat (Willer et al. 2014, updated)

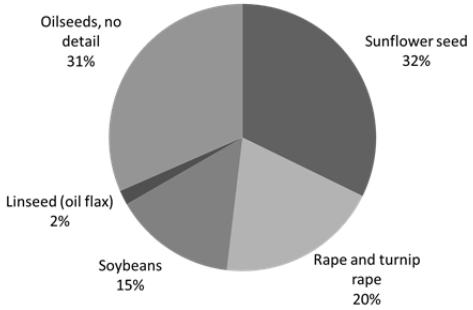

Figure 8: Organic oilseeds: Breakdown by crop 2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat (Willer et al. 2014, updated)

3.5.4 Dried pulses

In 2012, the organic dried pulses area in Europe was 245’640 hectares constituting 6 percent of the dried pulses area in Europe. It represented about 2.2 percent of the total organic agricultural land and more than 5 percent of the organic arable land. In the European Union organic dried pulses were grown on almost 220’653 hectares constituting 15 percent of the total dried pulses area. This represented 2.2 percent of the total organic agricultural land and almost 6 percent of the organic arable land.

Of all European countries, Spain has the largest dried pulses area with 45’195 hectares, followed by France (45’069 hectares) and Lithuania (26’486 hectares).

The highest shares of the overall organic dried pulses area were reached in Finland (62 percent), Lithuania (61 percent) and Austria (58.6 percent). The overall shares have a tendency to be high as dried pulses play an important role in organic farming.

Since 2007, the organic dried pulses area has more than doubled, and it has shown a growth of more than 140’000 hectares (Figure 9). The area has grown by 142 percent in Europe and by 145 percent in the European Union, thus exceeding the growth of the total organic agricultural land considerably. In the new member states of the European Union (the countries that became an EU member after 2014), the area has increased faster; by 12 percent from 2011 to 2012 (by 2 percent in the old member states).

Unfortunately, for dried pulses a breakdown for individual crops is not available for many countries; Eurostat communicates only one figure for “dried pulses”. From the data available, the most important dried pulses were beans (20’675 hectares), followed by peas (15’464 hectares), and lupins (7’227 hectares).

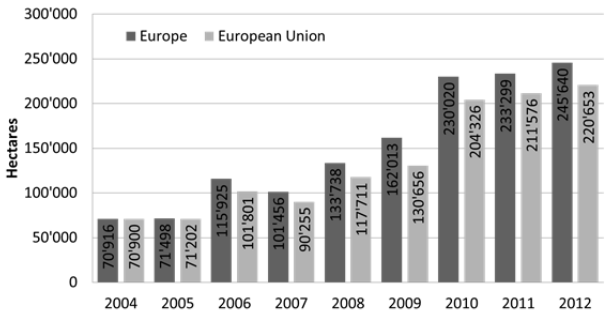

Figure 9: Organic dried pulses: Development in the European Union and Europe 2004-2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat (Willer et al. 2014, updated)

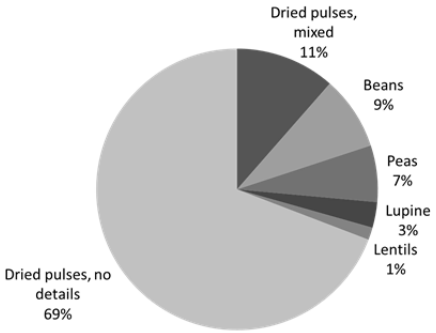

Figure 10: Organic dried pulses: Breakdown by crop 2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat (Willer et al. 2014, updated)

3.6 Livestock numbers

Statistics on the number of organic animals are incomplete and do not allow, for the moment, a complete picture of the sector. However, taking into account available information, the organic animal sector is developing at a fast pace in the European Union (European Commission 2014). The following should be noted:

- For this particular chapter the data from Eurostat and national data sources were used, which, in some cases, differ from the data provided by the ICOPP partners.
- Therefore, in some cases, there may also be contradictions with the data presented in the results chapter of this work (chapter 7), but it has not been possible to clarify all of these in the framework of the ICOPP project.
- For instance, for the Eurostat data and national data, no clear distinction is made between the number of animals slaughtered and the places or average numbers of stock over the year, and it is not clear which of these is given when “livestock numbers” are quoted. Adding up the data for pigs and poultry over all countries therefore has weaknesses, but it has not been possible to adjust all data in Europe to even out these differences.
- In addition, the data from FAO, which was used for the comparison with the overall total, was not clear on that point either.
- The data that are presented in the following should therefore be treated as an approximation to the overall picture.

Table 3 shows the numbers of organic animals in Europe and the European Union, the share or all animals for the respective species.

The strongest increase between 2007 and 2012 was noted for poultry: +64 percent in Europe (+62 percent in the European Union). However, beef and dairy cattle also grew substantially: (+54 percent), followed by pigs (+45 percent). For all animal species together, growth was slower than that for the organic agricultural land.

Organic animal production still remains limited in comparison with the total animal production in Europe and the European Union (between 0.5 and four percent depending on the animal species). The pork sector has the lowest weight. This stems partly from the difficulties posed by the provision of organic animal feed. The highest shares are found in the sheep and bovine sectors (see also European Commission 2014).

Table 3: Organic animal species in Europe and the European Union 2012

Species	Europe			European Union		
	Animals, heads	Share of all animals	Increase 2007-2012	Animals, heads	Share of all animals	Increase 2007-2012
Bovine animals	3'191'838	2.4 %	+ 54.0 %	2'996'070	3.4 %	+54.0 %
Pigs[3]	654'791	0.4 %	+28.3%	628'107	0.4 %	+27.3 %
Poultry	32'443'772	1.3 %	+61.6%	31'377'405	2.0%	+62.4%

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat, unpublished. Shares elaborated by FiBL based on FAO data (FAOSTAT 2014). It should be noted that FAOSTAT provides only totals for bovine animals, sheep, pigs and poultry without further specifications.

In many countries, organic animal husbandry began with beef, milk, and sheep production. The conversion of more extensive grass-based cattle and sheep production is comparatively easy. Milk and dairy products are among the pioneer products on the organic market. Germany is the largest organic milk producing country, with 670 million kg in 2012, followed by Denmark (478 million kg), France (451 million kg) and Austria (418 million kg) (Willer et al. 2014). All in all, 731‘000 organic dairy cows were kept in the EU-28 in 2012, constituting 3.2 percent of all dairy cows (European Commission 2014).

The conversion of farms with monogastric animals, like pigs and poultry, is far more complicated due to the requirements for animal husbandry in Regulation (EC) No 834/2007 and dependence on sometimes expensive feed crops. The most important countries keeping organic bovine animals are France, Austria, the UK, Sweden, and Germany. The most important sheep producers are the UK, Italy, Greece, Spain, and France. The most pigs are kept in Germany, Denmark, France, and the Netherlands. The most important countries producing organic poultry are France, Germany, and Italy. See also subsequent chapters.

3.6.1 Cattle

In 2012, there were more than 3.2 million heads of certified organic cattle in Europe and 3 million in the European Union. Since 2007, the number of cattle has grown by more than 50 percent.

The largest producers of organic cattle are, according to available data, France, Austria, the United Kingdom, Sweden, Germany, and Italy (Figure 11). In France, the largest bovine producer in the European Union, with a total herd of 19 million heads according to FAOSTAT, the organic sector represents about 2.3 percent of the sector.

The importance of the organic sector in relation with the whole bovine sector is the highest in Liechtenstein (28.2 percent of all cattle), Austria (19 percent), Sweden (18.8 percent), and Latvia (16.8 percent), Czech Republic (14.5 percent), and Denmark (11.5 percent). The share of organic bovine animals of all bovine animals represents 3.4 percent in the EU and 2.4 percent in the whole of Europe (2012).

[3] In the case of pigs, for organic only the fattening pics and breeding sows were counted.

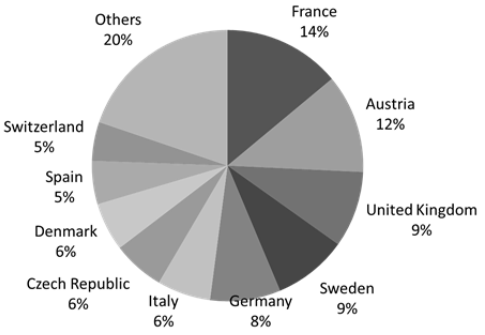

Figure 11: Distribution of organic bovine animals in Europe 2012 (total: 3.2 million heads)

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat, unpublished.

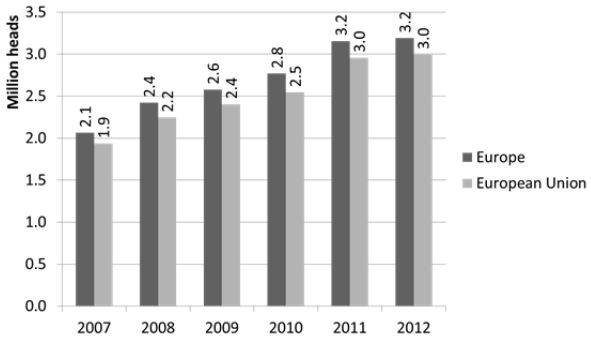

Figure 12: Growth of organic bovine animals 2007 to 2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat, unpublished.

3.6.2 Pigs

The European organic pig herd amounted to 0.65 million heads in 2012 (EU: 0.63 million heads). The largest producers were Germany and Denmark (0.14 million heads each).

The organic pigs still hold a very minor share of all European pigs (0.4). Their numbers increased by almost 30 percent between 2007 and 2012.

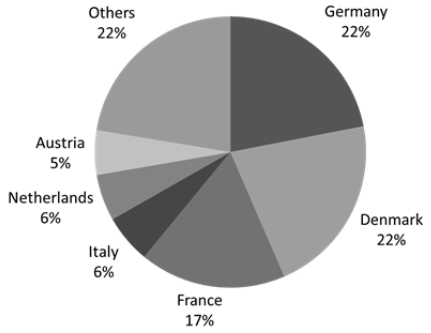

Figure 13: Distribution of organic pigs (fattening pigs and breeding sows) in Europe 2012 (total: 0.65 million)

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat, unpublished.

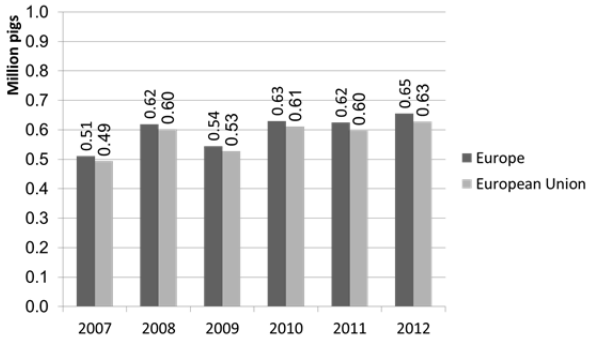

Figure 14: Growth of the numbers of organic pigs (fattening pigs and breeding sows) 2007 to 2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat, unpublished.

3.6.3 Poultry

In Europe, there were 32 million heads[4] of organic poultry in 2012 (EU 31 million). In total, 15.3 million organic laying hens were kept in the European Union in 2012 (3 percent of all laying hens). In some countries, the shares were much higher as eggs are one of the success stories of the organic market. In Luxembourg, Austria, and Sweden more than 10 percent of the laying hens were organic. The largest producers were France (3.36 million), Germany (3.30 million), and the Netherlands (2.12 million).

[4] Data include ducks, geese, and turkeys.

France is the leading country in the organic poultry sector with 11.6 million animals, of which about one third are laying hens.

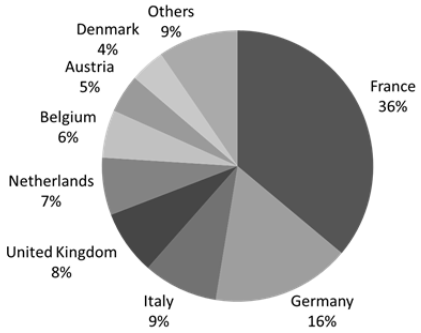

Figure 15: Distribution organic poultry in Europe 2012 (total: 32.4 million heads)

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat, unpublished.

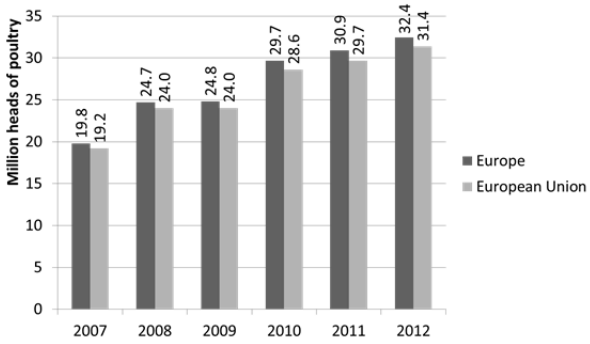

Figure 16: Growth of of organic poultry 2007 to 2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 based on national data sources and Eurostat, unpublished.

3.7 Market

3.7.1 Market overview

In 2012, the organic market continued to grow in Europe. The total value of the European organic market in 2012 was approximately 22.8 billion euros (EU: 20.9 billion euros). The largest markets were Germany, France, the UK, and Italy. The countries with the highest per capita spending were Switzerland, Denmark, and Luxembourg. Since 2004, when FiBL and AMI started their market data collection, the market has more than doubled. For more information about the European market see Schaack et al. 2014.

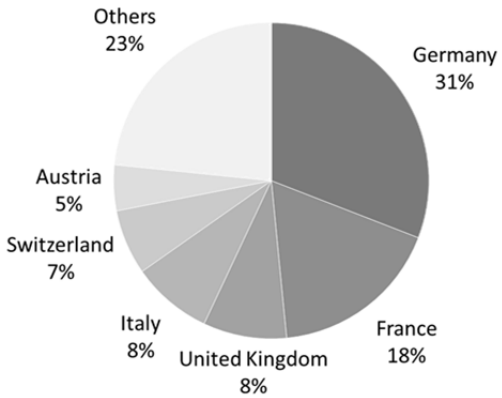

Figure 17: Europe: Distribution of organic retail sales 2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 (Schaack et al. 2014)

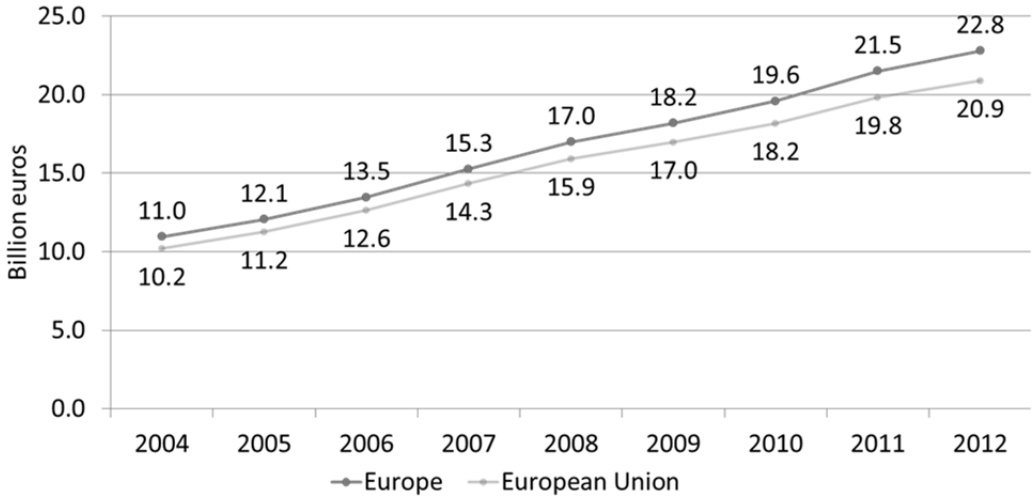

Figure 18: Europe: Growth of the organic retails sales in Europe and the European Union 2004-2012

Source: OrganicDataNetwork-FiBL-AMI survey 2006-2014 (Schaack et al. 2014)

3.7.2 The organic market for livestock products

Within the overall organic market in Europe, certain organic products are more dominant than others. A survey carried out as part of the OrganicDataNetwork (Willer et al. Schaack, 2013) showed the following results (Schaack et al. 2014).

Importance of products and product groups within the organic segment

- Fruit and vegetables are the pioneering organic products in Europe. They now have shares of between one third and one fifth of many national organic markets. They are especially strong in Italy, Ireland, Norway, Sweden, and Germany. All over Europe, the organic market is dominated by fresh products compared with the conventional markets.
- In many countries and in Northern Europe, in particular, animal products, especially milk and dairy products make up a high share of all organic products sold. Meat and meat products are very successful, with market shares of around 10 percent in Belgium, the Netherlands, Finland, and France. On the other hand, in many countries, the meat and meat-based product market is not yet well developed due to a lack of manufacturing capacities and high price premiums compared with conventional products.

Shares of organic products of the overall market

- A comparison of the market shares of organic products within the total market shows that one of the success stories in many European countries is that of eggs. According to the OrganicDataNetwork survey, organic eggs have market shares of up to 20 percent in Switzerland, and around 10 percent in most of the countries for which data was available. Sales of eggs reflect the high level of concern of consumers with regard to animal welfare and their readiness to pay relatively high price premiums. In Germany, for example, organic eggs are at least double the price of conventional eggs – one of the highest price differentials to be found within organic product groups (Schaack et al. 2014).

- After eggs, vegetables enjoy the highest market shares (in value), with organic accounting for 8 to 12 percent of all vegetables sold in Switzerland, Austria and Germany. In many countries, organic dairy products achieve market shares of about 5 percent of all dairy products sold. In Switzerland, the figure is even 10 percent (Schaack et al. 2014).
- On the other hand, products like beverages and meat (especially poultry) generally have low market shares due to high price premiums compared to conventional products (Schaack et al. 2014).

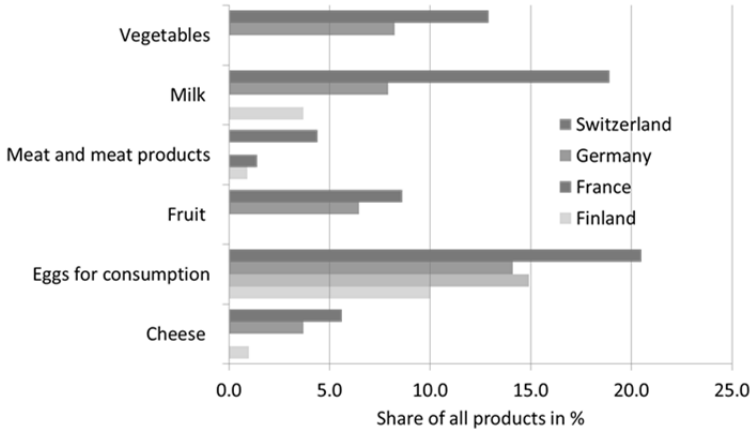

Figure 19: Europe: Importance of selected product groups in four European countries 2012

Source: OrganicDataNetwork-FiBL-AMI survey 2014 (Willer & Schaack 2014).

3.8 Conclusions

It may be expected that organic livestock numbers will continue to increase in the future. In many European countries, livestock products such as milk and eggs are already achieving market shares of 10 to 20 percent of the total market. The latest data on organic retail sales show that the market continues to grow for all products and product groups.

However, data on organic livestock and the market for livestock products is still scarce, and there are major data gaps. Furthermore there is a problem of definition as livestock numbers, particularly for monogastric animals are reported in different ways (average stock per year, animals slaughtered), which means that international or EU wide comparability is problematic. There is a clear need for more and better data and for permanent and reliable data collection efforts in this field.

4. Legal situation: EU regulation and protein feedstuffs

At the beginning of the ICOPP project in 2012, the 100 percent organic feeding regulation was planned to come into force on January 1, 2015. Article 43 of the current regulation (EC) No. 889/2008 allows exceptionality for the calendar years 2012, 2013, and 2014 for a maximum of 5 percent of non-organic protein feed to be used for pigs and poultry. In the last month of the ICOPP project, the European Commission published the prolongation of the exceptional rule for non-organic protein feed until the end of 2017. The European Commission justified its decision with the following statement: Organic protein has not been available in sufficient quality or quantity on the EU market to meet the nutritional requirements of pigs and poultry raised on organic farms. The production of organic protein crops does not meet demand. It is, therefore, appropriate to extend the exceptional possibility of using a limited proportion of non-organic protein feed for a limited time period.

Nevertheless, there is a protein gap for Europe, also with the 5 percent non-organic feed for pigs and poultry, as the results of this project show (see chapter 7). Therefore, alternative feed components are needed.

5. Literature Review

Many demand and supply calculations of the different studies are based on Eurostat data. Therefore, it should be mentioned that the Eurostat calculation, based on animal numbers and land use, holds a certain potential for error (Witten et al., 2014). In addition, no unified diets were assumed in the different studies as a calculation basis. Besides these uncertainties, studies may not always contain the same focus; e.g., some consider calculations only for soybeans, others for protein crops. Some compute demand and supply for crude protein, others for the whole plant. All these aspects have to be kept in mind when looking at the study results.

5.1 History of conventional protein feed

In Europe, the demand for protein feed clearly exceeds its production. Different reasons for the protein gap exist. One reason is the ban of meat and bone meal in the nutrition of livestock as a consequence of the BSE (bovine spongiform encephalopathy) crisis in 2001. The sudden disappearance of protein feed, which had been used for decades, caused major problems in the procurement of adequate protein feed materials. Oilseed and protein crops became increasingly important as substitutes of processed animal protein (PAP). However, due to international trade agreements (the General Tariff and Trade Agreement [GATT] and the Blair House Agreement), which allowed the European Union (EU) to protect its cereal production but at the same time admitted duty-free imports of oilseed and protein crops into the EU, European farmers faced a competitive disadvantage, and European oilseed and protein crop cultivation stalled (Häusling, 2010). Besides these intergovernmental barriers, there are impediments related to the special needs of the plants. The cultivation of protein crops is challenging due to their higher predisposition to diseases and pests than that of grain crops; moreover, the management of protein crops is more demanding (Böhm, 2009; Guyer et al., 2014). Furthermore, cereals are more competitive due to their yield stability and higher performance (BMELV, 2012), which makes their cultivation more attractive to farmers. The lower market price of protein crops, therefore, is unable to compensate farmers for the associated risks (Schaack et al., 2011). Due to the circumstances outlined above, knowledge about the cultivation of these crops has disappeared, and research projects are no longer funded. In the past ten years, protein crop production declined by 30 percent; only 3 percent of the arable land within the EU is occupied by protein crops (Häusling, 2010). At the same time, demand for meat and, as a consequence, the demand for animal feed increased. According to Bues et al. (2013), the production of beef, pig, and poultry meat in the EU-27 has risen from 17 to 43 million metric tons in the last 50 years, with a particularly large increase in pig and poultry meat.

Soy is imported to fill the protein gap. It predominantly comes from South America, where it is produced under questionable conditions for the environment and local populations. Extinction of small-scale farming structures, deforestation of the rain forest, and the destruction of the habitat of humans and animals are the consequences of unbounded soybean cultivation (Pengue, 2005). European soybeans account for less than 10 percent of the soybeans crushed in the EU, and more than 70 percent of the soybean meal used in feed is imported (Krautgartner et al., 2013).

5.2 The growing demand for organic protein feed

The prohibition of meat and bone meal did not affect the organic sector because, at that time, it was not permitted as feed for organic animals. But most of the other above mentioned reasons for the protein gap also applies to organic agriculture. Additionally, the permanent growth of the organic sector - in the last decade, the number of holdings and area in the EU-27 has grown by 50 percent or more (European Commission, 2014a) - and the thereby resulting growth of animal numbers also contribute. In organic agriculture, solely organically produced feedstuff is permitted, but due to the lack of organic high quality protein feed materials and the concerns about an inadequate supply with essential amino acids and the possibility of resulting health and performance problems, the transition period for using up to 5 percent conventional feed components for monogastric animals again has been prolonged until the end of 2017 (European Commission, 2014b). Nonetheless, organic farms are also highly dependent on soy import. Although organic soy is free of genetic modification and its cultivation is liable to organic principles, its import is in conflict with the organic approach, where the feed supply should be predominantly farm-owned production (BMELV, 2014) and the nutrient cycle within a farm system should be closed (Padel and Sundrum, 2006).

Organic animal husbandry has to face two major challenges, which are closely intertwined, first, to provide an adequate protein and amino acid supply to have healthy and well-performing animals, and second, to find sources, which are not only in line with the organic approach and certification rules, but are also produced regionally or at least within Europe. To date, it is not possible to guarantee a sufficient protein supply for monogastrics without soy from overseas and without conventional feed ingredients. According to the Thünen Working Paper 23 by Witten et al. (2014), there are at least 9’200 metric tons of conventional feed ingredients used annually in European organic feed grinders, not to mention the farmers who also buy conventional ingredients to mix in their own feed. However, the available amount of organic, high-quality protein sources - organic potato protein and corn gluten - is only about 150 and 500 metric tons per year, and an expansion of production is not likely (Witten et al., 2014). Padel (2005) calculated an under-supply of high-quality protein sources in 2002 and 2003 of approximately 100’000 metric tons (33’000 ha), in the case of an assumed 100 percent organic feeding to monogastric animals. According to Padel’s (2005) calculations, pulses could reduce the deficit of high quality protein by 50 percent, but the resulting higher demand for pulses would increase its deficit and increase the demand for feed cereals. Based on Eurostat data in 2010, Herrle (2011) calculated a demand for soybeans, specifically high-quality protein for monogastric animals, of 117’000 metric tons, which would correspond to a cultivation area of 58’500 ha. According to his data, there was a supply for only 18’000 ha; so, production clearly undersupplies the demand. Schaack et al. (2011) computed data for Germany with an assumed share of 10 percent protein crops (fava beans, peas, or lupine) in diets in 2009. Thus, Germany had a demand of 70’000 metric tons of organic protein crops, whereas only 44’000 metric tons could be produced within the country. According to an analysis of the EU organic sector by the European Commission (2010), 104’000 hectares of organic protein crops, specifically dried pulses, had been cultivated in 2007 within the EU. Supposing that 1 hectare of land yields 3.0 metric tons of protein crops like peas, beans, or soy, it would amount to approximately 312’000 metric tons (FiBL calculations). According to Schaack et al. (2011), who calculated a demand of 70’000 metric tons of organic protein crops only for Germany, Germany alone would need almost one-fifth of the produced organic crops in the EU to cover its requirements.

Früh (2014) described different solutions to fill the protein gap. One solution is to use resources effectively. Ruminants should be mainly fed by roughage. Calculations in this project show that there is an enormous potential to save protein components, while feeding ruminants with raw-

fodder, not with concentrate feed. The possibility of feeding PAP (processed animal protein) or insect protein is not possible because of the legal situation (Früh, 2014). When it comes to evaluating the potential of different alternative protein plants, protein peas are given the greatest importance by experts for Switzerland, probably because they are already used in organic production and are well known for their good protein quality (Guyer et al., 2014). According to the experts interviewed during the survey, organic potato protein seems to have the lowest potential due to its lack of availability. Within the framework of the focus group on protein crops launched by the European Commission in 2013 as part of the activities carried out under the European Innovation partnership for Agricultural Productivity and Sustainability (EIP AGRI[5]), participating experts attested to better possibilities for oil-rich protein crops like soy, rapeseed oil, sunflower, and alfalfa than for starchy protein crops like peas and field beans. However, the competitiveness of protein crops may differ between regions within Europe due to different climate zones and different possibilities of the crops to deal with the environment and their ability to seize the habitat opportunities (Schreuder and De Visser, 2014).

As discussed above, supply from organic protein sources is still insufficient despite the implementation of national development plans and programs under the Common Agricultural Policy (CAP) to increase protein crop production in Europe (BMELV, 2012). Therefore, there are concerns that a 100 percent organic diet may not supply sufficient essential amino acids, leading to health and performance problems in monogastric animals. According to Witten et al. (2014), organic soy press cake, which comes mainly from China, is already imported and seems to have a high potential to meet the increased demand. However, this is not in line with the ecological and social idea of organic agriculture. Therefore, the experts who have been interviewed for the Thünen Working Paper 23 discussed different approaches to solving the growing gap in the supply of high-quality protein by 2015, when the transition period would have expired if the European Commission had not recently agreed on a further extension until the end of 2017. The proposed solutions range from maintaining the transition period (as has happened), through gradually reducing the interim arrangement to support the development of the market and provisionally maintaining the transition period for young stock and poultry, to developing and permitting the use of alternative protein sources (Witten et al., 2014). Besides these solution strategies, great importance is attached to Europe-wide collaboration projects like the Donau Soy Project (Guyer et al., 2014). According to Krön (2014), there are about 1.8 million hectares of abandoned area in the Donau region. Five million metric tons of soy per year could be produced until 2018. Still, the conventional soy produced by the Donau project could only cover 10 percent of the European demand (Sandmayr, A., 2014, cited in Guyer et al., 2014). Because cultivation of protein crops is not competitive at the moment, experts of the EIP AGRI report recommend a step-by-step approach (Schreuder, R. and De Visser, C., 2014). They consider local value chains like the Donau Soy Project to provide a stepping stone to support this difficult period of low competitiveness and yields. Further, they claim that more interaction between the stakeholders, namely farmers, advisors, researchers, NGO's, and governments, would be necessary to promote an increased protein crop production. Also, breeding companies should be integrated with the dialogue, even though their investment will be limited until protein crops gain higher market prices. Therefore, sufficient support for pre-breeding and breeding activities of public research institutes should be warranted (Schreuder, R. and De Visser, C., 2014).

[5] More information about the EIP Agri is available on http://ec.europa.eu/eip/agriculture/

6. Methods

6.1 The survey

In order to collect the data on protein supply and demand in Europe, the ICOPP project partners were asked to supply data from their countries. The actual survey among the project partners, which took mainly place in 2013, was preceded by a pilot survey with which the actually availability of the data needed was tested. For the survey, a questionnaire we designed. The data received were entered into a database for further processing, including the calculation of concentrate feed, crude protein, and essential amino acid supply and demand.

6.2 Design of questionnaire

In order to collect the basic data on organic feed products, livestock and feeding practices, a questionnaire was designed. This questionnaire consisted of four sheets.

- Feedstuff availability in Europe, covering indicators like area, production, production used for feeding, exports and imports;
- Livestock numbers and related indicators;
- Feeding practices;
- Questionnaire for mills to assess, on an exemplary basis, main feed components, exports and imports.

Even though some basic data (area and livestock numbers) are available from national sources or Eurostat, very little of the needed information (production for feeding, animals slaughtered versus animal places, domestic use, exports and imports) is available from official sources. Partners were therefore asked to contribute this information through research in their countries.

6.2.1 Feedstuff availability (crop area and production)

The first questionnaire sheet on crop production was designed to assess the feedstuff availability in the ICOPP partner countries.

The questionnaire for feedstuff availability is based on the Eurostat questionnaire for organic agriculture, questionnaire sheet on land use and crops (Eurostat 2012). However, for the purpose of the ICCOP survey, those crops that are not relevant as feedstuffs were taken out; on the other hand, additional crops, in particular protein crops were added. Also, the classification and terminology for feedstuffs according to the European Commission's Catalogue of feed materials (European Commission 2011) was applied.

The questionnaire included the following indicators:

- Total in-conversion agricultural land [ha]
- Total fully converted organic agricultural land [ha]
- Total organic area [ha]
- Total organic production [mt]
- Total estimated organic area [ha] used for animal feed
- Total estimated production animal feed [mt]
- Export animal feed [mt]
- Import animal feed [mt]
- Average annual yield [mt/ha]
- Country's degree of self-sufficiency with organic feedstuffs [%]

› For exports: Name 3 key export destinations and their share

In addition, partners were asked to provide the data source and add any relevant remarks.

The partners were asked to use existing data from their country or Eurostat for crop area and production, as well as for exports and imports for 2011.

The information gained from this questionnaire was used to calculate the protein availability in the ICOPP partner countries.

6.2.2 Livestock

Questionnaire sheet "2) Livestock details"

The aim of this questionnaire was to calculate the feed demand in each country. Therefore, the numbers of the most important livestock categories were asked. The structure of the questionnaire followed that of the Eurostat questionnaire for organic farming (Eurostat 2012); however, some additional indicators were inserted in order to be able to calculate the protein needs (e.g. average slaughter age). The project partners were asked to use existing data from their country or Eurostat for animal numbers for 2011. Sometimes there were two possibilities like "number of places" or "slaughtered animals per year". Partners were asked to fill in just one if there is a reliable data source for that figure. Apart from the livestock numbers, further indicators were asked (needed to calculate the protein needs).The questionnaire can be downloaded at http://orgprints.org/28067.

The project focuses on feeding of pigs and poultry. To calculate the availability of concentrate feed for pigs and poultry, it was necessary to estimate the consumption of the ruminants (Table 12) to evaluate the potential of countries' own feed production for pigs and poultry.

	Unit	Value	Source	Remark
Bovine animals		**0.0**		
Bovine animals, no details	[No.]			
Bovine animals less than 1 year old	**[No.]**			
Bovine animals aged between 1 and 2 years	**[No.]**			
Bovine animals of two years and older	**[No.]**	**0.0**		
Bovine animals of two years and older, no details	[No.]			
Dairy cows	[No.]			
Suckler cows	[No.]			

Figure 20: Questionnaire sheet "2) Livestock details": bovine animals were categorized in different ages and production system.

Depending on the source of the data, different units were available. Therefore, the questionnaire offered different possibilities to fill in the data. Especially in the fatting pig calculation the data collection was heterogenic between countries. Some sources provided the number of slaughtered pigs per year, some the number of places. To calculate numbers which were not available in the country, the questionnaire included questions on the production system (see second part in Figure 21).

Pigs	Unit	Value	Source	Remark
Pigs, no details	[No.]			
Fattening pigs: Number of slaughtered animals	[No. of slaughtered animals/year]			
Fattening pigs: Number of heads at the end of the year (places)	[No. of places]			
Breeding sows	[No. of places]			
Other pigs (included rearing gilts)	[No. of places]			
Further info				
Average replacement rate of sows (in percent)	[Percent]			
Average number of piglets weaned per sow/year	[No.]			
Average number of litter per sow/year	[No.]			
Average age of fattening pigs at slaughter (in days)	[Days]			
Average weight at slaughter of fattening pigs (in kg)	[Kilograms]			

Figure 21: Questionnaire sheet "2) Livestock details": pigs were mainly categorized in fattening pigs and breeding sows. Questions about the production data were integrated.

In poultry production, data was collected from the main species, laying hens, rearing pullets and broilers. In addition the questionnaire included numbers of turkey, ducks and geese (Figure 22).

Poultry	Unit	Value	Source	Remark
Poultry, no details	[No.]			
Broilers (all ages)	[No. slaughtered animals/year]			
Laying hens	[No. places]			
Rearing pullets (organic rearing only)	[No. places]			
Turkeys	[No. slaughtered animals/year]			
Ducks	[No. slaughtered animals/year]			
Geese	[No. slaughtered animals/year]			
Other poultry	[No. slaughtered animal/year]			
Further info				
Average age of broilers at slaughter	[Days]			
Average weight of broilers at slaughter (kg)	[Kilograms]			
Number of eggs produced	[No./laying period]			
Average duration of laying period (days)	[Days]			

Figure 22: Questionnaire sheet "2) Livestock details": poultry are categorized in several species. Questions about the production date were integrated.

6.2.3 Feeding practices

For these data no official / ready statistics exist. It was necessary to interview experts to help estimate these data for each country. These have been advisors or animal husbandry experts in organic sector organisations or researchers. It was up to the partners to estimate the mean out of the range of the experts' estimations.

Moreover it was asked to include *innovative* feeding systems into these sheets.

Questionnaire sheet 3a "Common feeding practices pigs", sheet 3b "Common feeding laying hens", sheet 3c "Common feeding broilers"

This part of the questionnaire gathered information on the general feeding practice for pigs, laying hens and broilers in the country. The aim was to get an overview about production data which could be combined with the key feed components and their provenance. In addition, special feeding practices were collected.

6.2.4 Questionnaire for Mills

Questionnaire sheet 4 “Questionnaire for mills”

The questionnaire for mills evaluated the trading of feedstuffs regarding the relationship between import, export and the total domestic volume. Economically relevant feed mills were asked by the partners to give information.

The terminology for feedstuffs is according to European Commission (2011).

In some countries it was not possible to get a complete overview of the feed production. Therefore we suggested interviews with the two or three most important mills, to get an indication for the relation of domestic and imported feedstuffs. It was the responsibility of the partner to either send the questionnaire to the mill or to make a telephone interview.

6.3 Calculation of protein availability

The total estimated feedstuff production volume in metric tons (mt) in each country was collected with the "questionnaire feed production". These numbers where estimated by the project partners in Austria, Germany, Finland, France, the Netherlands, Sweden, Switzerland and the UK. The Danish partners supplied information on yields and based on this, feedstuff production by crop was calculated. For Lithuania the production in metric tons was calculated using FAO yield data.

The feedstuff volume in metric tons by crop was used to calculate the total yearly dry matter (in kilograms), energy (Mega joule), crude protein (in kilograms) and essential amino acid content, which is relevant for feeding.

The Agroscope feed data base was used for the composition and nutritional values of each crop and selected secondary products (Universität Zürich and Agroscope, 2014) (Table 4).

As protein and amino acid content are lower in organically grown cereals, we reduced the protein and amino acid amount in cereals by 15 percent for the calculations. In Table 4, the original data from the Agroscope database is shown.

Table 4: Energy, protein and amino acid content of different crops/products, from the Agroscope database

Product	Dry matter [g/kg]	Gross Energy [MJ/kg DM]	Digestible Energy Pigs [MJ/kg DM]	Protein Content [g/kg DM]	LYS [g/kg DM]	MET [g/kg DM]	CYS [g/kg DM]
Barley	870	18.1	15.05	116.3	4.21	1.93	2.7
Beans, field	870	19.15	14.94	296	17.96	2.46	3.68
Beet roots	190	16.62	14.1	70	3.57	0.81	1.2
Carrots	120		1.31	11.5	0.84	0.18	0.18
Cereals FP	870	18.0275	16.052	125.75	3.8755	2.062	3.054
Cereals, no details	870	18.1	15.05	116.3	4.2	1.93	2.7
Grain legumes FP	870	19.19	15.362	281.75	17.353	2.361	3.762
Legume seeds, cereal mixed	870	18.3	15.4	153.4	8.27	2.01	3
Linseed	920	26.7	18.67	225.4	8.7	4.47	4.27
Linseed cake/expeller	900		11.86	303.8	11.77	5.61	5.8
Lupine	870	20.93	15.53	358.7	16.57	2.28	4.74
Maize, grain	870	18.44	16.63	96.3	2.8	2	2.37
Mixed cereal grains	870	18.21	30.48	121	4.005	1.917	3.077
Mixed cereals	870	18.21		121	4.005	1.917	3.077
Oats	870	18.81	13.41	119.4	4.48	1.9	3.5
Peas, field	870	18.69	16.15	227.6	16.4	2.19	3.6
Potato protein	900	22.88	18.48	833.5	122.96	18.68	12.52
Potatoes, fresh	220	16.6	13.72	93.7	4.65	1.43	1.65
Rape and	950	27.4	20.7	207.2	12.91	4.48	5.59

Product	Dry matter [g/kg]	Gross Energy [MJ/kg DM]	Digestible Energy Pigs [MJ/kg DM]	Protein Content [g/kg DM]	LYS [g/kg DM]	MET [g/kg DM]	CYS [g/kg DM]
turnip rape							
Rape cake	910	20.63	14.9	328.5	20.24	6.48	8.81
Rye	870	17.86	16.08	113	4.04	1.73	2.92
Sorghum	880	18.36	15.73	113.77	2.4	1.89	1.89
Soy cake	880	20.73	16.47	487.5	30.01	6.86	7.59
Soybeans	900	23.11		407	25.16	5.75	6.36
Soybeans, extruded	950	23.344	18.46	410.675	25.384	5.8	6.421
Spelt	870	18.42	12.24	136.7	3.71	2.02	3.33
Sugar beet	230		3.19	13.1	0.67	0.15	0.23
Sunflower cake	910	21.03	12.31	281.1	10.68	6.39	5.08
Sunflower seed	950			189.1	7.19	4.3	3.42
Triticale	870	17.95	16.2	121.7	4.33	2.13	3.12
Wheat bran	875	18.435	10.047	178	7.418	2.741	2.902
Wheat gluten	930	23.563	18.745	860.63	12.897	13.22	17.68
Wheat, soft, animal feed	870	18.08	16.42	135.6	3.29	2.11	3.19
Whey/Whey powder	970	16.26		131	10.51	2.15	3.14
Yeast, beer	930		14	460.3	30.99	7.21	5.66

Source: Universität Zürich and Agroscope (2014, formerly Agroscope: Schweizerische Futtermitteldatenbank)

6.4 Calculation of concentrate feed demand

6.4.1 Harmonisation of data provided

For the calculation of the feed demand, animal numbers were used as delivered by the ICOPP partners via the ICOPP questionnaire. The data on organic animals were delivered, however, in several units and indicators (animals slaughtered, places, counted number at a specific date, heads per year, etc.); they were therefore transformed to harmonized units/indicators as shown in Table 5.

Table 5: Base for the harmonisation of indicators and units as used for the calculation of the demand of feed, crude protein, lysine, methionine and cysteine

Species	Indicator/Unit	Calculation
Pigs		
Breeding sows	Litter per year (No./year)	If not indicated otherwise in the questionnaire, we calculated with an average of 2 litters per sow and year.
Fattening pigs	Fattening pigs slaughtered per year (No./year)	For most countries the number of slaughtered animals was reported in the questionnaire. For both Austria and the UK, the number of places was reported. This was converted into slaughtered pigs, using the following formulas: Austria: turnaround of 2.4 fattening pigs per place; UK: turnaround of 2.8 fattening pigs per place.
Gilts	Raised gilts per year (No./year)	If the number of raised gilts was not indicated in the questionnaire their number was calculated using the annual replacement rate for breeding sows. On average, across the ICOPP countries, 30 to 50 percent of the breeding sows are replaced each year.
Weaners	Raised weaners per year (No./year)	It was assumed that the number of weaners corresponds to 106% of the fattening pigs. We assumed that each fattening pig was also a weaner, and 6% were added for gilts, losses, etc.)
Poultry		
Broilers	Broilers slaughtered per year (No./year)	For most countries the number of slaughtered animals was shown in the questionnaire. For countries, which did not supply the number of slaughtered animals, we assumed a turnaround quote between 4.15 and 4.55 per 'animal place' or 'counted animal heads at a specific date' depending on the country.
Laying hens	Laying hen places (No)	For most countries, the number of places was reported in the questionnaire. In the case of the numbers provided by Eurostat, where the laying hen number includes the rearing pullets, we assumed that 70 percent of these laying hen places.
Rearing pullets	Number of raised rearing pullets per year (No./year)	Some countries reported the number of rearing pullets. Where only a total number of laying hens was reported, it was assumed that the number of rearing pullets raised annually corresponded to the number of laying hens.
Cattle		
Dairy cows	Number of dairy cows (No.)	No transformation needed
Suckler cows	Number of suckler cows in Livestock Units (LSU)	One suckler cow corresponds to 0.8 livestock units.

Source: FiBL and ICOPP partners

6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand

For livestock an average concentrate feed, crude protein, and amino acid demand per single unit (e.g. “one fattening pig”) was estimated. It should be noted that for certain units these demands had to be adjusted to the countries’ feeding practices:

Breeding sows

The concentrate feed, protein, and amino acid demand for breeding sows was determined using the feeding recommendations and nutritive value tables of the Swiss Agroscope Liebefeld Posieux (ALP 2004). These feeding recommendations of ALP were used for all countries, including, however, suggestions for modifications made by the ICOPP partners.

The 42 days of lactation period and 140.5 days of non-lactation period (empty/non pregnant and gestation) are included in the calculations.

Table 6: Basic assumptions for the demand of concentrate feed, crude protein, lysine and methionine and cysteine for breeding sows

Species	Unit	Feed DM [kg]	CP [kg]	Lys [kg]	Met [kg]	Met + Cys [kg]
Breeding sows	per litter	671	110	5.13	1.88	3.74

Source: ALP 2004, modified by FiBL/ICOPP partners

Fattening pigs

The feed, protein, and amino acid demand for fattening pigs was determined using the feeding recommendations of the Swiss Agroscope Liebefeld Posieux (ALP 2004).

Table 7: Basic assumptions for the demand of concentrate feed, crude protein, lysine, methionine and cysteine for fattening pigs

Species	Country	Slaughter weight [kg]	Age at slaughter [Days]	Feed DM [kg]	CP [kg]	Lys [kg]	Met [kg]	Met + Cys [kg]
Fattening pigs	Austria	125	220	280	52	2.63	0.782	1.55
	Denmark	102	171	235	39	2.24	0.722	1.43
	Finland		225	280	52	2.63	0.782	1.55
	France	120	190	280	52	2.63	0.782	1.55
	Germany	125		280	52	2.63	0.782	1.55
	Lithuania	125	220	280	52	2.63	0.782	1.55
	Nether-lands	117.5	200	280	52	2.63	0.782	1.55
	Sweden			280	52	2.63	0.782	1.55
	Switzer-land	125	220	280	52	2.63	0.782	1.55
	United Kingdom	100	182	235	39	2.24	0.722	1.43

Source: ALP 2004, modified by FiBL/ICOPP partners

These feeding recommendations and nutritive value tables of ALP were used for all countries, including, however, suggestions for modifications made by the ICOPP partners.

For Denmark and the United Kingdom the numbers (Table 7) were adjusted because of lower age and/or lower average weight of fattening pigs at slaughter.

Gilts

The feed, protein, and amino acid demand for gilts was determined using the feeding recommendations of the Swiss Agroscope Liebefeld Posieux (ALP 2004).

These feeding recommendations and nutritive value tables of ALP were used for all countries, including, however, suggestions for modifications made by the ICOPP partners.

Table 8: Basic assumptions for the demand concentrate feed, crude protein, lysine, methionine and cysteine for fattening pigs

Species	Unit	Feed DM [kg]	CP [kg]	Lys [kg]	Met [kg]	Met + Cys [kg]
Gilts	per head	254	40	2.33	0.75	1.49

Source: ALP 2004, modified by FiBL/ICOPP partners

Weaners

The concentrate feed, crude protein, and amino acid demand for weaners was determined using the feeding recommendations of the Swiss Agroscope Liebefeld Posieux (ALP 2004, p. 55, ALP-Fütterungsempfehlungen und Nährwerttabellen für Schweine“).

These feeding recommendations and nutritive value tables of ALP were used for all countries, including, however, suggestions for modifications made by the ICOPP partners.

It was assumed that a pig is a weaner for 84 days, and that in the first 5 to 6 weeks the main feed intake is milk from the sow, with a small amount of additional feed in the 6th week. The suckling period was therefore not considered in the calculation for the feed demand.

Table 9: Basic assumptions for the demand of concentrate feed, crude protein, lysine, methionine and cysteine for weaners

Species	Unit	Feed DM [kg]	CP [kg]	Lys [kg]	Met [kg]	Met + Cys [kg]
Weaners	per head	27.4	5.26	0.36	0.115	0.232

Source: ALP 2004, modified by FiBL/ICOPP partners

Broilers

Demand was calculated according to Bellof and Schmidt (2005; “Broiler production with 100 percent organic feed is possible”) and for France according to Leroyer and Lubac (2009). As broilers in France are kept until much older, about 115 days instead of 56 to 80 days in most other European countries, the demand was adjusted upwards.

Table 10: Basic assumptions for the demand of concentrate feed, crude protein, lysine, methionine and cysteine for broilers

Species	Unit		Feed DM [kg]	CP [kg]	Lys [kg]	Met [kg]	Met + Cys [kg]
Broilers	Per slaughtered animal	Other countries	4.87	1.07	0.052	0.019	0.042
		France	6.03	1.3	0.063	0.023	0.051

Source: FiBL elaboration based on Bellof and Schmidt (2005) and Leroyer and Lubac (2009).

Laying hens

For the calculation of concentrate feed, protein, and amino acid, the Layer management guide of Lohmann was used. The same figures were used for all countries.

Table 11: Basic assumptions for the demand of concentrate feed, crude protein, lysine, methionine and cysteine for broilers

Species	Unit	Feed DM [kg]	CP [kg]	Lys [kg]	Met [kg]	Met + Cys [kg]
Laying hen	One place	41.86	6.923	0.301	0.142	0.265

Source: FiBL elaboration based on Lohmann (no year)

Rearing pullets

For the calculation of concentrate feed, protein, and amino acid, the Layer management guide of Lohmann of used. The same figures were used for all countries.

Table 12: Basic assumptions for the demand of concentrate feed, crude protein, lysine, methionine and cysteine for rearing pullets

Species	Unit	Feed DM [kg]	CP [kg]	Lys [kg]	Met [kg]	Met + Cys [kg]
Rearing pullet	Per head	6.864	1.169	0.058	0.025	0.047

Source: FiBL elaboration based on Lohmann (no year)

Dairy cows

Only the concentrate feed part (energy and protein feed) of the dairy cow diet was included for the calculation of the feed and protein demand of cattle. Amino acids were calculated in order to get a complete picture of amino acids use, even though they are not essential for dairy cows.

As the percentage of concentrate feed varies from country to country, from only 10 percent in Switzerland to up to 40 percent in Sweden, the demand was adjusted for each country.

In order to calculate the demand for concentrate feed, the data of Wiesinger (2008) was applied, using the data for the 3rd and 4th lactation (7,000 kg milk per year), based on Wiesinger's recommendations that concentrate feed (energy and protein feed) corresponds to approximately 15 percent of all feed (dry matter). Composition of the energy feed according to Wiesinger (2008) was 30 percent wheat, 30 percent triticale, 20 percent maize corn, 20 percent barley. Protein feed was 35 kg horse beans in total.

Table 13: Basic assumptions for the demand of concentrate feed for dairy cows in the ICOPP countries

Country	
Austria	For Austria, the basic calculation from Wiesinger (2008) was applied.
Denmark	About 30% compound feed, calculated from the base calculation.
Finland	Total feed is about 6500 kg DM, 30% are cereals, and 5% protein feed, mainly rapeseed cake (in total about 35% feed).
France	About 1040 kg DM concentrate feed, which is about 16% of total feed (6500kg DM) with 18% protein content.
Germany	With farms similar to Austria in the south and high output farms in the north, 20% concentrate feed was assumed.
Lithuania	20% concentrate feed assumed.
Netherlands	~1370 kg concentrate feed. Main components are wheat 25%, barley 25%, and sunflower expeller cake 10%. The protein content varies between 140 (B-pellet) and 160 (A-pellet) gram per kg.
Sweden	Up to 40 % is concentrate feed; the calculation base from Finland was used.
Switzerland	10% concentrate feed
United Kingdom	About 1525 kg DM concentrate feed with about 18% protein content.

Source: FiBL elaboration based information from the ICOPP partners

Table 14: Basic assumptions for the calculation of the demand of feed, crude protein, lysine, methionine and cysteine for dairy cows (only for concentrate feed)

Species	Country	Unit	Concentrate feed DM [kg]	CP [kg]	Lys [kg]	Met [kg]	Met + Cys [kg]
Dairy cows	Austria	Per head and year	883	112	3.737	1.83	4.423
	Denmark		1765	223	7.475	3.66	8.846
	Finland		2275	330	14.435	5.514	14.399
	France		1042	187	8.47	2.87	6.6
	Germany		1177	149	4.983	2.44	5.897
	Lithuania		1177	149	4.983	2.44	5.897
	Sweden		2275	332	14.476	5.535	14.461
	Switzerland		588	75	2.492	1.22	2.949
	United Kingdom		1525	274	12.696	9.736	5.897
	Netherlands		1370	200	7.67	3.36	8.2

Source: FiBL elaboration based on Wiesinger (2008) supplemented with information from the ICOPP partners

6.5 Extrapolation to Europe

To calculate the demand and the availability of protein feed in Europe, the area data for crops and the livestock numbers from the FiBL database on organic agriculture (Willer et al., 2014) was used.

Europe was defined as all countries of the European Union, the candidate and potential candidate countries[6], the countries of the European Free Trade Association (EFTA)[7] and other European countries (Moldova, Russian Federation, and Ukraine). For the ICOPP countries, the ICOPP data was used.

All countries were put into categories from 1 to 4, depending on their land use, crops grown and livestock numbers (Table 15). E.g., if a country had a lot of livestock but only a small area for feedstuff production, it was assumed that feedstuffs were imported. The categories were as follows:

- Category 1: Ninety and more percent of feedstuff has to be imported
- Category 2: Thirty and more percent of feedstuff has to be imported
- Category 3: Neutral
- Category 4: Export countries

Table 15: Country category from 1 to 4 as import or export feed country

Country	Category
Albania	-
Austria	2
Belgium	1
Bulgaria	4
Croatia	3
Cyprus	3
Czech Republic	4
Denmark	2
Estonia	4
Finland	3
France	2
Germany	2
Greece	3
Hungary	4
Iceland	-
Ireland	2
Italy	4
Kosovo	-
Latvia	3
Liechtenstein	1
Lithuania	4

[6] Candidate countries include: Albania, Iceland, Montenegro, Serbia, The former Yugoslav Republic of Macedonia, Turkey. Potential candidates are Bosnia and Herzegovina and Kosovo.

[7] Iceland, Liechtenstein, Norway, and Switzerland

Country	Category
Luxembourg	1
Malta	-
Moldova	4
Montenegro	-
Netherlands	1
Norway	2
Poland	4
Portugal	2
Romania	4
Russian Federation	4
Serbia	3
Slovakia	3
Slovenia	2
Spain	4
Sweden	2
Switzerland	1
The former Yugoslav Republic of Macedonia	3
Turkey	4
Ukraine	4
United Kingdom	2

No category: For some countries, no sufficient data was available.

Source: FiBL elaboration based 2012 data or organic livestock numbers and arable cropland (FiBL unpublished).

The calculation of the demand of concentrate feed in Europe is based on Eurostat data and national data sources. The number of animals was transformed into livestock units. The livestock units were multiplied with the concentrate feed (DM) and with the crude protein demand (Table 16).

Table 16: Livestock units (LSU) table with additional concentrate feed and crude protein need per livestock unit a year

Animal Species	LSU	DM [mt]	Crude protein [kg]	Remark
Suckler cows	0.8	0.6	84	//
Dairy cows	1	1.525	250	DM_t = dry matter per LSU in metric tons
Breeding sows	0.55	2.68	440	DM= 671kg per litter, 2.2 litter a year = 671/0.55*2.2 = 2680 kg
Fattening pigs	0.17	1.65	306	DM= 280 kg per animal = 1650 kg per LSU
Broilers	0.004	1.25	275	
Laying hens	0.01	4.13	689	

Source for LSU: Agridea 2014, other indicators: FiBL calculation

To calculate the possible export amount from the category 4 countries, the total production of organic cereals, oilseeds, and dried pulses was calculated, based on the area data, using yield estimates (Table 17) in order to estimate the possible export volume. The data were extracted from the FiBL database on organic agriculture (Willer/Lernoud 2014).

Table 17: Yield estimates used for the countries of category 4 countries to calculate total production

Crop	Estimated yields [t/ha]
Barley	3
Wheat	3
Wheat, no details	3
Wheat, spring	3
Wheat, winter	3
Wheat, durum	3
Wheat, soft, no details	3
Triticale	3
Rye	2.5
Rye, no details	2.5
Maize, grain	6
Oats	3
Sorghum	3.5
Cereals, other	3

Crop	Estimated yields [t/ha]
Cereals, no details	3
Mixed pulses and cereals	3
Beans, dry	2
Beans, field	2.5
Peas, field	2
Pulses, other	2
Protein crops, no details	2
Soybeans	2.5
Rape and turnip rape, no details	1.5
Sunflower seed	2.5
Linseed	1
Sweet lupine (seeds)	2

Source: FiBL estimates based on FAOSTAT (2014), information of ICOPP partners, De Ponti et al., (2012), Seufert et al. 2012

6.6 Data processing and storage - The FiBL database as a tool for calculating feedstuff availability and demand

The ICOPP database consists of a main table and a number of dimension and transformation tables.

6.6.1 Main table

The main data table contains the data collected among the partners using the ICOPP questionnaire and the data from the ALP database with the data on energy, protein and amino acid content of different crops/products (Agroscope 2012).

ICOPP_TAB

inserted	modified	Id	Package	Year	Country	Kultur	Kult	Indicator	Label	Value
22.05.2012	12.05.2012	311871	Lebensministeri	2010	Austria	Cattle less than 1 year old		Animals [heads]	ICOPP	110836
22.05.2012	12.05.2012	311893	Lebensministeri	2010	Austria	Suckler cows		Animals [heads]	ICOPP	85210
22.05.2012	12.05.2012	311892	Lebensministeri	2010	Austria	Cattle aged between 1 an		Animals [heads]	ICOPP	90097
22.05.2012	12.05.2012	311891	Lebensministeri	2010	Austria	Bovine animals, no detail		Animals [heads]	ICOPP	3778
22.05.2012	12.05.2012	311872	Lebensministeri	2010	Austria	Dairy cows		Animals [heads]	ICOPP	94638
08.04.2013	12.05.2012	514735	BOKU f002	2011	Austria	Bovine animals aged betv		Animals [heads]	ICOPP	84547
08.04.2013	12.05.2012	514736	BOKU f002	2011	Austria	Bovine animals, no detail		Animals [heads]	ICOPP	286
08.04.2013	12.05.2012	514737	BOKU f002	2011	Austria	Dairy cows		Animals [heads]	ICOPP	94149
08.04.2013	12.05.2012	514738	BOKU f002	2011	Austria	Suckler cows		Animals [heads]	ICOPP	85002
08.04.2013	12.05.2012	514741	BOKU f002	2011	Austria	Breeding sows		Animals [heads]	ICOPP	4000
08.04.2013	12.05.2012	514734	BOKU f002	2011	Austria	Bovine animals less than		Animals [heads]	ICOPP	115651
08.04.2013	12.05.2012	514740	BOKU f002	2011	Austria	Pigs, no details		Animals [heads]	ICOPP	3556
22.05.2012	07.10.2011	311886	Lebensministeri	2010	Austria	Pigs, no details		Animals [heads]	ICOPP	6964
22.05.2012	07.10.2011	311873	BioAustria f001	2010	Austria	Breeding sows		Animals [heads]	ICOPP	4000
19.11.2012	19.11.2012	514963	AU f002	2011	Denmark	Suckler cows		Animals [heads]	ICOPP	8349
19.11.2012	19.11.2012	514622	Eurostat f385	2011	Denmark	Bovine animals, no detail		Animals [heads]	ICOPP	5
19.11.2012	19.11.2012	514964	Eurostat f385	2011	Denmark	Rearing pullets		Animals [heads]	ICOPP	428814
19.11.2012	19.11.2012	514623	Eurostat f385	2011	Denmark	Breeding sows		Animals [heads]	ICOPP	6421
19.11.2012	19.11.2012	514620	Eurostat f385	2011	Denmark	Broilers		Animals [heads]	ICOPP	248055
19.11.2012	19.11.2012	514632	Eurostat f385	2011	Denmark	Pigs, other		Animals [heads]	ICOPP	79182
19.11.2012	19.11.2012	514635	Eurostat f385	2011	Denmark	Bovine animals, other		Animals [heads]	ICOPP	30248
19.11.2012	19.11.2012	514634	Eurostat f385	2011	Denmark	Fattening pigs		Animals [heads]	ICOPP	85626
19.11.2012	19.11.2012	514624	Eurostat f385	2011	Denmark	Cattle for slaughter		Animals [heads]	ICOPP	68024
19.11.2012	19.11.2012	514631	Eurostat f385	2011	Denmark	Other livestock, no detail		Animals [heads]	ICOPP	28
19.11.2012	19.11.2012	514625	Eurostat f385	2011	Denmark	Cattle of 2 years and over		Animals [heads]	ICOPP	169779
19.11.2012	19.11.2012	514965	Eurostat f385	2011	Denmark	Bovine animals for meat p		Animals [heads]	ICOPP	63024
19.11.2012	19.11.2012	514626	Eurostat f385	2011	Denmark	Dairy cows		Animals [heads]	ICOPP	63158
19.11.2012	19.11.2012	514630	Eurostat f385	2011	Denmark	Laying hens		Animals [heads]	ICOPP	550178
19.11.2012	19.11.2012	514633	Eurostat f385	2011	Denmark	Poultry, other		Animals [heads]	ICOPP	109984
12.05.2012	12.05.2012	311304	AU f001	2010	Denmark	Cattle of 2 years and over		Animals [heads]	ICOPP	156
12.05.2012	12.05.2012	311306	AU f001	2010	Denmark	Cattle less than 1 year old		Animals [heads]	ICOPP	26383
12.05.2012	12.05.2012	311303	AU f001	2010	Denmark	Suckler cows		Animals [heads]	ICOPP	8394
12.05.2012	12.05.2012	311305	AU f001	2010	Denmark	Cattle aged between 1 an		Animals [heads]	ICOPP	67183
07.10.2011	07.10.2011	311291	Eurostat f317	2010	Denmark	Dairy cows		Animals [heads]	ICOPP	62407
24.07.2013	24.07.2013	514905	MTT f001	2011	Finland	Laying hens		Animals [heads]	ICOPP	112661
24.07.2013	24.07.2013	514902	MTT f001	2011	Finland	Bovine animals aged betv		Animals [heads]	ICOPP	10612
24.07.2013	24.07.2013	514903	MTT f001	2011	Finland	Bovine animals less than		Animals [heads]	ICOPP	11152
24.07.2013	24.07.2013	514904	MTT f001	2011	Finland	Bovine animals of 2 years		Animals [heads]	ICOPP	13051

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Figure 23: Main table of the ICOPP database

Table 18: Indicators used in the ICOPP main table

Indicator	Explanation
Animals, piglets weaned per sow/year [no]	Average number of piglets weaned per sow and year
Animals, places [no]	Number of places
Animals, replacement rate [percent]	Replacement rate for animals, e.g. 40 % for breeding sows
Animals, slaughter age [days]	Average age at slaughter [days]
Animals, slaughter weight [kg]	Average slaughter weight [kg]
Animals, slaughtered [no]	Number of slaughtered animals per year
App metabolizable energy poultry [MJ/kg DM]	Apparent metabolizable energy poultry, N-corrected per kg dry matter of different crops

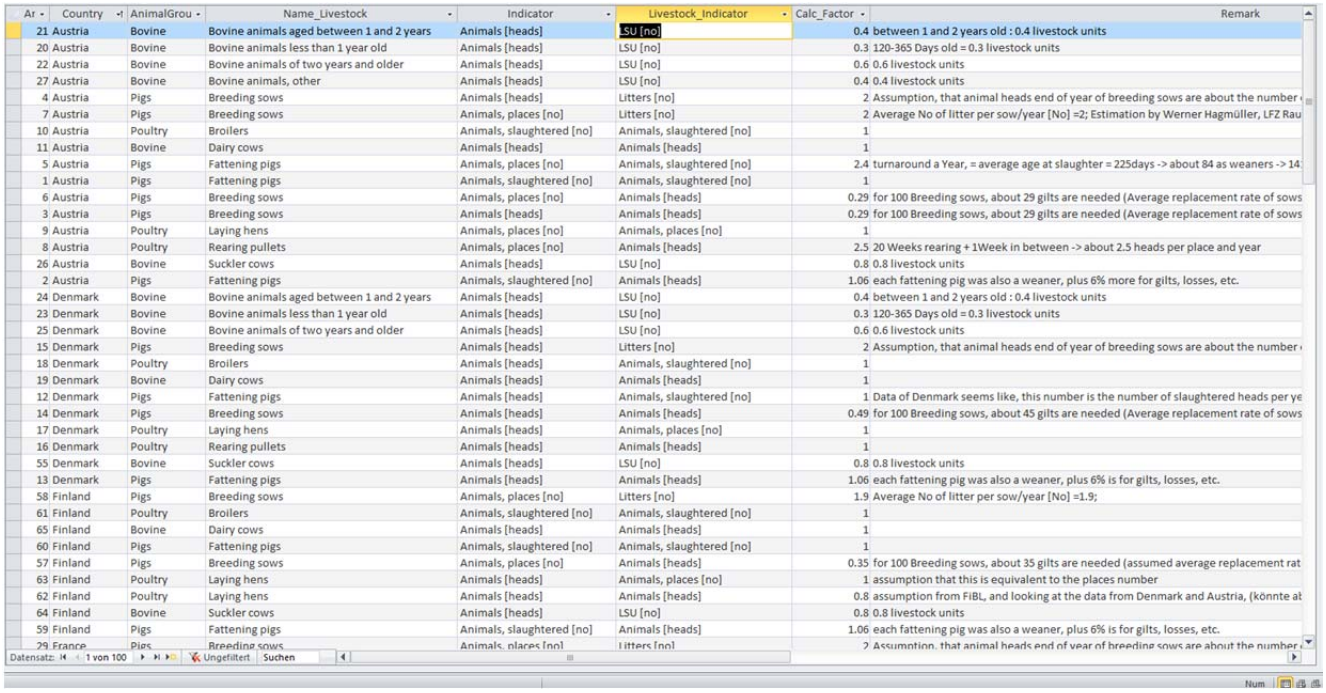
Indicator	Explanation
Area, EF [ha]	Estimated area for feedstuffs (needed in order to calculate feedstuff production in metric tons if not otherwise available)
Area, fully converted, share EF[%]	Fully converted area, estimated share in % used for animal feed production
Area, share feedstuffs [%]	Share of the organic area that is used for feedstuffs (needed in order to calculation feedstuff production in metric tons if not otherwise available).
Average age of broilers at slaughter [days]	Average age of broilers at slaughter in days
Average age of fattening pigs at slaughter [days]	Average age of fattening pigs at slaughter in days
Average duration of laying periods [days]	Average duration of laying periods in days
Average feed conversion ratio [kg feed/egg produced]	Feeding practices estimates: Average feed conversion ratio [kg feed/egg produced]
Average feed conversion ratio [kg feed/kg weight gain]	Feeding practices estimates: Average feed conversion ratio [kg feed/kg weight gain]
Average No of litter per sow/year [No]	Average number of litters per sow/year
Average No of piglets weaned per sow/year [No]	Average number of piglets weaned per sow and year
Average replacement rate of sows [%]	Average replacement rate of sows in percent
Average weight at slaughter of fattening pigs [kg]	Average weight at slaughter of fattening pigs [kg]
Average weight of broilers at slaughter [kg]	Average weight of broilers at slaughter [kg]
Crude protein content [g/kg DM]	Crude protein content in g per kg dry matter
CYS [g/kg DM]	Cysteine content in g per kg dry matter
Digestible Energy Pigs [MJ/kg DM]	Digestible Energy of Pigs in Mega Joule per kg dry weight
Dry matter [g/kg]	Approximate dry matter of different crops in g/kg or kg/metric tons
Export, EF [mt]	Export estimated for feedstuffs (not used for calculations as no data available)
Gross energy [MJ/kg DM]	Gross energy in Mega Joule per kg dry matter
Import, EF [mt]	Import estimated for feedstuffs (not used for calculations as no data available).
LYS [g/kg DM]	Lysine content in g per kg dry matter
MET [g/kg DM]	Methionine content in g per kg dry matter
MET+CYS [g/kg DM]	Methionine plus Cysteine content in g per kg dry matter
Metabolizable energy pigs [MJ/kg DM]	Metabolizable energy of pigs in Mega Joule per kg dry matter
Number of eggs produced [No./laying period]	Number of eggs produced [No./laying period]
Percentage key feed component (pigs) [%]	Estimated percentage of key feed component and provenience in pig fodder ration.
Percentage key feed component (poultry) [%]	Estimated percentage of key feed component and provenience in poultry fodder ration.
Production, EF [mt]	Estimated production of feedstuffs based on area and yield information

Indicator	Explanation
	(e.g. from FAO) if not delivered by partners
Self-sufficiency by animal type country level [%]	Estimated degree of self-sufficiency of feed on country level in percent by animal type
Self-sufficiency by animal type farm level [%]	Estimated degree of self-sufficiency of feed on farm level in percent by animal type
Self-sufficiency feedstuffs on country level [%]	National self-sufficiency of feed (only available for France, for the other countries calculated by the ICOPP project)

6.6.2 Dimension and transformation tables

Animal number transformation table

The animal number transformation table holds the calculation factor (for example one broiler place corresponds to 4.2 slaughtered animals a year).



Ar	Country	AnimalGrou	Name_Livestock	Indicator	Livestock_Indicator	Calc_Factor	Remark
21	Austria	Bovine	Bovine animals aged between 1 and 2 years	Animals [heads]	LSU [no]	0.4	between 1 and 2 years old : 0.4 livestock units
20	Austria	Bovine	Bovine animals less than 1 year old	Animals [heads]	LSU [no]	0.3	120-365 Days old = 0.3 livestock units
22	Austria	Bovine	Bovine animals of two years and older	Animals [heads]	LSU [no]	0.6	0.6 livestock units
27	Austria	Bovine	Bovine animals, other	Animals [heads]	LSU [no]	0.4	0.4 livestock units
4	Austria	Pigs	Breeding sows	Animals [heads]	Litters [no]	2	Assumption, that animal heads end of year of breeding sows are about the number
7	Austria	Pigs	Breeding sows	Animals, places [no]	Litters [no]	2	Average No of litter per sow/year [No] =2; Estimation by Werner Hagmüller, LFZ Rau
10	Austria	Poultry	Broilers	Animals, slaughtered [no]	Animals, slaughtered [no]	1	
11	Austria	Bovine	Dairy cows	Animals [heads]	Animals [heads]	1	
5	Austria	Pigs	Fattening pigs	Animals, places [no]	Animals, slaughtered [no]	2.4	turnaround a Year, = average age at slaughter = 225days -> about 84 as weaners -> 14
1	Austria	Pigs	Fattening pigs	Animals, slaughtered [no]	Animals, slaughtered [no]	1	
6	Austria	Pigs	Breeding sows	Animals, places [no]	Animals [heads]	0.29	for 100 Breeding sows, about 29 gilts are needed (Average replacement rate of sows
3	Austria	Pigs	Breeding sows	Animals [heads]	Animals [heads]	0.29	for 100 Breeding sows, about 29 gilts are needed (Average replacement rate of sows
9	Austria	Poultry	Laying hens	Animals, places [no]	Animals, places [no]	1	
8	Austria	Poultry	Rearing pullets	Animals, places [no]	Animals [heads]	2.5	20 Weeks rearing + 1Week in between -> about 2.5 heads per place and year
26	Austria	Bovine	Suckler cows	Animals [heads]	LSU [no]	0.8	0.8 livestock units
2	Austria	Pigs	Fattening pigs	Animals, slaughtered [no]	Animals [heads]	1.06	each fattening pig was also a weaner, plus 6% more for gilts, losses, etc.
24	Denmark	Bovine	Bovine animals aged between 1 and 2 years	Animals [heads]	LSU [no]	0.4	between 1 and 2 years old : 0.4 livestock units
23	Denmark	Bovine	Bovine animals less than 1 year old	Animals [heads]	LSU [no]	0.3	120-365 Days old = 0.3 livestock units
25	Denmark	Bovine	Bovine animals of two years and older	Animals [heads]	LSU [no]	0.6	0.6 livestock units
15	Denmark	Pigs	Breeding sows	Animals [heads]	Litters [no]	2	Assumption, that animal heads end of year of breeding sows are about the number
18	Denmark	Poultry	Broilers	Animals [heads]	Animals, slaughtered [no]	1	
19	Denmark	Bovine	Dairy cows	Animals [heads]	Animals [heads]	1	
12	Denmark	Pigs	Fattening pigs	Animals [heads]	Animals, slaughtered [no]	1	Data of Denmark seems like, this number is the number of slaughtered heads per ye
14	Denmark	Pigs	Breeding sows	Animals [heads]	Animals [heads]	0.49	for 100 Breeding sows, about 45 gilts are needed (Average replacement rate of sows
17	Denmark	Poultry	Laying hens	Animals [heads]	Animals, places [no]	1	
16	Denmark	Poultry	Rearing pullets	Animals [heads]	Animals [heads]	1	
55	Denmark	Bovine	Suckler cows	Animals [heads]	LSU [no]	0.8	0.8 livestock units
13	Denmark	Pigs	Fattening pigs	Animals [heads]	Animals [heads]	1.06	each fattening pig was also a weaner, plus 6% is for gilts, losses, etc.
58	Finland	Pigs	Breeding sows	Animals, places [no]	Litters [no]	1.9	Average No of litter per sow/year [No] =1.9;
61	Finland	Poultry	Broilers	Animals, slaughtered [no]	Animals, slaughtered [no]	1	
65	Finland	Bovine	Dairy cows	Animals [heads]	Animals [heads]	1	
60	Finland	Pigs	Fattening pigs	Animals, slaughtered [no]	Animals, slaughtered [no]	1	
57	Finland	Pigs	Breeding sows	Animals, places [no]	Animals [heads]	0.35	for 100 Breeding sows, about 35 gilts are needed (assumed average replacement rat
63	Finland	Poultry	Laying hens	Animals [heads]	Animals, places [no]	1	assumption that this is equivalent to the places number
62	Finland	Poultry	Laying hens	Animals [heads]	Animals [heads]	0.8	assumption from FiBL, and looking at the data from Denmark and Austria, (könnte at
64	Finland	Bovine	Suckler cows	Animals [heads]	LSU [no]	0.8	0.8 livestock units
59	Finland	Pigs	Fattening pigs	Animals, slaughtered [no]	Animals [heads]	1.06	each fattening pig was also a weaner, plus 6% is for gilts, losses, etc.
29	France	Pigs	Breeding sows	Animals, places [no]	Litters [no]	2	Assumption, that animal heads end of year of breeding sows are about the number

Figure 24: Animal number transformation table of the ICOPP database

Feed per animal type and unit table

The feed per animal type and unit table holds the data on the feed, protein and amino acid demand per single animal type and unit, shown in chapter 6.4.2.

Feeding_ID	Country	AnimalGrou	Type	SlaughterWeig	Days	Total_Food_kg_D	Total_VES_	Total_ME_MJ	Total_Raw_Protein_kg	Total_Lys_kg	Total_MetCys_kg
76	Lithuania	Bovine	Dairy cows			1177		18162	148.85	4.983	5.897
88	Netherlands	Bovine	Dairy cows			1950		28641	284.7	10.907	11.667
29	Sweden	Bovine	Dairy cows			2275		33670	332	14.476	14.461
67	Germany	Bovine	Dairy cows			1177		18162	148.85	4.983	5.897
26	France	Bovine	Dairy cows			1042		16088	187.31	8.47	6.6
17	Denmark	Bovine	Dairy cows			1765.5		27243	223.27	7.475	8.846
38	Switzerland	Bovine	Dairy cows			588.5		9081	74.42	2.492	2.949
48	Finland	Bovine	Dairy cows			2275		33594	330.23	14.435	14.399
9	Austria	Bovine	Dairy cows			882.75		13622	111.6	3.737	4.423
57	United Kingdo	Bovine	Dairy cows			1525		23533	274	12.696	5.897
28	France	Bovine	Suckler cows			294		4540	37.21	1.246	1.474
47	Denmark	Bovine	Suckler cows			588		9081	74.42	2.492	2.949
75	Germany	Bovine	Suckler cows			294		4540	37.21	1.246	1.474
78	Lithuania	Bovine	Suckler cows			294		4540	37.21	1.246	1.474
39	Switzerland	Bovine	Suckler cows			294		4540	37.21	1.246	1.474
37	Sweden	Bovine	Suckler cows			1765.5		27243	223.27	7.475	8.846
27	Austria	Bovine	Suckler cows			294		4540	37.21	1.246	1.474
89	Netherlands	Bovine	Suckler cows			294		4540	37.21	1.246	1.474
13	Denmark	Pigs	Breeding sows			671	8680	8330	110	5.13	3.74
22	France	Pigs	Breeding sows			671	8680	8330	110	5.13	3.74
40	Switzerland	Pigs	Breeding sows			671	8680	8330	110	5.13	3.74
50	Finland	Pigs	Breeding sows			671	8680	8330	110	5.13	3.74
58	United Kingdo	Pigs	Breeding sows			671	8680	8330	110	5.13	3.74
30	Sweden	Pigs	Breeding sows			671	8680	8330	110	5.13	3.74
4	Austria	Pigs	Breeding sows			671	8680	8330	110	5.13	3.74
81	Netherlands	Pigs	Breeding sows			671	8680	8330	110	5.13	3.74
68	Germany	Pigs	Breeding sows			671	8680	8330	110	5.13	3.74
80	Lithuania	Pigs	Fattening pigs	125	220	280	4333	4160	52	2.63	1.55
1	Austria	Pigs	Fattening pigs	125	220	280	4333	4160	52	2.63	1.55
10	Denmark	Pigs	Fattening pigs	102	171	228	3520	3380	42	2.13	1.26
19	France	Pigs	Fattening pigs	95	190	228	3520	3380	42	2.13	1.26
51	Finland	Pigs	Fattening pigs		225	280	4333	4160	52	2.63	1.55
69	Germany	Pigs	Fattening pigs	125		280	4333	4160	52	2.63	1.55
31	Sweden	Pigs	Fattening pigs			280	4333	4160	52	2.63	1.55
87	Netherlands	Pigs	Fattening pigs	117.5	200	280	4333	4160	52	2.63	1.55
66	United Kingdo	Pigs	Fattening pigs	100	182	234.62	3505.8	3365.6	38.39	2.239	1.432
41	Switzerland	Pigs	Fattening pigs	125	220	280	4333	4160	52	2.63	1.55

Figure 25: Feed per animal type and unit table of the ICOPP database

Crop and livestock dimension table

The crop and livestock dimension table shows crop and livestock groups. Example: A broiler belongs to poultry, which is livestock.

inser	modified	ID		Crop1	Crop2	Crop3	Crop4	Crop5	Crop	ProductM
16.12	16.12.2008	1174	All	Livestock and livestock products	Livestock	Bees	Bees	Bees	Bees	
12.2008	16.12.2008	2452	All	Livestock and livestock products	Livestock	Bees	Bees, no details	Bees, no details	Bees, no details	
03.2011	15.03.2011	1997	All	Livestock and livestock products	Livestock	Goats	Billy goats	Billy goats	Billy goats	
05.2010	13.05.2010	1874	All	Livestock and livestock products	Livestock	Bovine animals	Bison	Bison	Bison	
03.2011	15.03.2011	1992	All	Livestock and livestock products	Livestock	Pigs	Boars	Boars	Boars	
07.2012	01.07.2012	2431	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals	Bovine animals	Bovine animals	Cattle
12.2008	16.12.2008	1183	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals aged between 1 and 2 y	Bovine animals aged between '	Bovine animals aged between 1 and 2 years	Cattle
05.2009	30.05.2009	1533	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals aged between 1 and 2 y	Bovine animals aged between '	Bovine animals aged between 1 and 2 years, for slaug	Cattle
03.2011	15.03.2011	1986	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals aged between 1 and 2 y	Bovine animals aged between '	Bovine animals aged between 1 and 2 years, no detail	Cattle
07.2012	01.07.2012	2432	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals aged between 1 and 2 y	Bovine animals aged between '	Bovine animals aged between 1 and 2 years, other	Cattle
04.2010	08.04.2010	1872	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals for meat production	Bovine animals for meat produc	Bovine animals for meat production	Cattle
03.2011	15.03.2011	1987	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals less than 1 year old	Bovine animals less than 1 yea	Bovine animals less than 1 year old	Cattle
12.2008	16.12.2008	1184	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals less than 1 year old	Bovine animals less than 1 yea	Bovine animals less than 1 year old, no details	Cattle
04.2010	08.04.2010	2523	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals not for meat production	Bovine animals not for meat pro	Bovine animals not for meat production	Cattle
05.2012	16.12.2008	2144	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals of 2 years and over	Bovine animals of 2 years and	Bovine animals of 2 years and over	Cattle
12.2008	16.12.2008	1187	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals of 2 years and over	Bovine animals of 2 years and	Bovine animals of 2 years and over for slaughter	Cattle
05.2012	16.12.2008	2145	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals of 2 years and over	Bovine animals of 2 years and	Bovine animals of 2 years and over, no details	Cattle
12.2008	16.12.2008	1189	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals of 2 years and over	Bovine animals 2 years and ove	Bovine animals of 2 years and over, other	Cattle
12.2008	16.12.2008	1191	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals, no details	Bovine animals, no details	Bovine animals, no details	Cattle
11.2010	05.11.2010	1907	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals, other	Bovine animals, other	Bovine animals, other	Cattle
06.2010	02.06.2010	1877	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals of 2 years and over	Breeding bulls	Breeding bulls	
12.2008	16.12.2008	1201	All	Livestock and livestock products	Livestock	Pigs	Breeding sows	Breeding sows	Breeding sows	
12.2008	16.12.2008	1206	All	Livestock and livestock products	Livestock	Poultry	Broilers	Broilers	Broilers	
12.2008	16.12.2008	1185	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals less than 1 year old	Calves	Calves for slaughter	
12.2008	16.12.2008	1186	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals less than 1 year old	Calves	Calves, other	
12.2008	16.12.2008	2566	All	Livestock and livestock products	Livestock	Camels	Camels	Camel, no details	Camel, no details	
12.2008	16.12.2008	1188	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals of 2 years and over	Dairy cows	Dairy cows	
12.2008	16.12.2008	2584	All	Livestock and livestock products	Livestock	Bovine animals	Bovine animals of 2 years and over	Dairy cows, total	Dairy cows, total	
07.2012	01.07.2012	2474	All	Livestock and livestock products	Livestock	Other livestock	Deer	Deer	Deer	
07.2012	01.07.2012	2475	All	Livestock and livestock products	Livestock	Other livestock	Deer	Deer, no details	Deer, no details	
11.2010	05.11.2010	1909	All	Livestock and livestock products	Livestock	Poultry	Other poultry	Ducks	Ducks	
01.2009	19.01.2009	1503	All	Livestock and livestock products	Livestock	Equidae	Equidae	Equidae	Equidae	
07.2012	01.07.2012	2435	All	Livestock and livestock products	Livestock	Equidae	Equidae, no details	Equidae, no details	Equidae, no details	
12.2008	16.12.2008	1202	All	Livestock and livestock products	Livestock	Pigs	Fattening pigs	Fattening pigs	Fattening pigs	
11.2010	05.11.2010	1910	All	Livestock and livestock products	Livestock	Poultry	Other poultry	Geese	Geese	

Datensatz: 1 von 75 Kein Filter Suchen

Figure 26: Crop and livestock dimension table of the ICOPP database

Protein and amino acid content reduction table

The table “Protein and amino acid content reduction” determines whether the protein and amino acid content of a specific crop/product, listed in the ALP database, should be taken as is for the calculation or corrected by a certain amount. For example as organic cereals have a reduced protein and amino acid content, it was decided to reduce its content for cereals by 15 percent.

ID_Bio_Prot	Kultur	Factor	Zum Hinzufügen klicken
6	Barley	0.85	
20	Beans, field	1	
19	Beet roots	0.85	
36	Carrots	1	
30	Cereals FP	0.85	
28	Cereals, no details	0.85	
29	Grain legumes FP	1	
27	Legume seeds, cereal mixed	1	
12	Linseed	0.85	
31	Linseed cake/expeller	1	
1	Lupine	1	
9	Maize, grain	0.85	
21	Maize, green	0.85	
26	Mixed cereal grains	0.85	
25	Mixed cereals	0.85	
7	Oats	0.85	
2	Peas, field	1	
24	Potato protein	1	
18	Potatoes, fresh	1	
14	Rape and turnip rape	0.85	
13	Rape cake	0.85	
10	Rye	0.85	
8	Sorghum	0.85	
16	Soy cake	1	
15	Soybeans	1	
37	Soybeans, extruded	1	
4	Spelt	0.85	
35	Sugar beet	1	
17	Sunflower cake	0.85	
23	Sunflower seed	0.85	
11	Triticale	0.85	
32	Wheat bran	1	
38	Wheat gluten	1	
5	Wheat, soft, animal feed	0.85	
3	Whey/Whey powder	1	
34	Yeast, beer	1	
(Neu)		0	

Figure 27: Protein and amino acid content reduction table

Feeding practice table

This table holds data from the questionnaire “feeding practice” of pigs, laying hens and broilers This table contains the main components of farm own grown and bought-in feedstuff in percent.

ICOPP_dim_Feedingpractice

ID	Annum	Country	Animal	AnimalType	Crop	SelfOrBougl	Value	
1	2011	Austria	Pigs	Fattening pigs	Triticale	Own	0.25	
2	2011	Austria	Pigs	Fattening pigs	Barley	Own	0.25	
3	2011	Austria	Pigs	Fattening pigs	Peas, field	Own	0.147	Pe
4	2011	Austria	Pigs	Fattening pigs	Potato protein	Bought	0.02	
5	2011	Austria	Pigs	Fattening pigs	Soy cake	Bought	0.06	
6	2011	Austria	Pigs	Fattening pigs	Triticale	Bought	0.1	
7	2011	Austria	Pigs	Fattening pigs	Barley	Bought	0.1	
8	2011	Austria	Pigs	Fattening pigs	Beans, field	Own	0.073	Pe
9	2011	Austria	Poultry	Broilers	Wheat, soft, ar	Own	0.3	
10	2011	Austria	Poultry	Broilers	Maize, grain	Own	0.3	
11	2011	Austria	Poultry	Broilers	Beans, field	Own	0.075	
12	2011	Austria	Poultry	Broilers	Peas, field	Own	0.075	
13	2011	Austria	Poultry	Broilers	Potato protein	Bought	0.05	
14	2011	Austria	Poultry	Broilers	Soy cake	Bought	0.08	
15	2011	Austria	Poultry	Broilers	Beans, field	Bought	0.075	
16	2011	Austria	Poultry	Broilers	Peas, field	Bought	0.075	
17	2011	Austria	Poultry	Laying hens	Wheat, soft, ar	Own	0.1	
18	2011	Austria	Poultry	Laying hens	Maize, grain	Bought	0.17	
21	2011	Austria	Poultry	Laying hens	Potato protein	Bought	0.044	
22	2011	Austria	Poultry	Laying hens	Soybeans	Bought	0.07	
23	2011	Austria	Poultry	Laying hens	Beans, field	Bought	0.05	
24	2011	Austria	Poultry	Laying hens	Peas, field	Bought	0.05	
25	2011	Austria	Poultry	Laying hens	Triticale	Bought	0.2	
26	2011	Austria	Poultry	Laying hens	Wheat, soft, ar	Bought	0.1	
28	2011	Denmark	Pigs	Fattening pigs	Triticale	Own	0.13	
29	2011	Denmark	Pigs	Fattening pigs	Wheat, soft, ar	Own	0.2	
31	2011	Denmark	Pigs	Fattening pigs	Oats	Own	0.13	
32	2011	Denmark	Pigs	Fattening pigs	Soy cake	Bought	0.2	
33	2011	Denmark	Pigs	Fattening pigs	Dried grass me	Bought	0.1	
34	2011	Denmark	Pigs	Fattening pigs	Potato protein	Bought	0.05	
36	2011	Denmark	Poultry	Laying hens	Wheat, soft, ar	Bought	0.44	
37	2011	Denmark	Poultry	Laying hens	Soy cake	Bought	0.13	
38	2011	Denmark	Poultry	Laying hens	Maize, grain	Bought	0.1	
39	2011	Denmark	Poultry	Broilers	Maize, grain	Bought	0.2	
40	2011	Denmark	Poultry	Broilers	Soy cake	Bought	0.2	
41	2011	Denmark	Poultry	Broilers	Wheat, soft, ar	Bought	0.44	
42	2011	Sweden	Pigs	Fattening pigs	Barley	Own	0.45	
43	2011	Sweden	Pigs	Fattening pigs	Oats	Own	0.25	

Figure 28: Feeding practice calculation table of the ICOPP database

7. Results

7.1 Protein availability and demand by ICOPP country

7.1.1 General note for the feeding practice tables in each country:

The values in the tables “Feeding practices and derived calculated feed, energy and protein consumption” (Example Austria: Table 24 and Table 25) are only approximate estimates provided by experts in the individual ICOPP countries.

Determining what proportion of a feed crop is grown on-farm (home-grown) rather than purchased by the farmers is difficult, and the amounts can vary from year to year and from region to region. For example, if cereals are of high quality, they are sold for human consumption, and cheaper cereals are purchased by farmers for feed.

It is even more difficult to determine the share of home-grown crops in European poultry holdings as it is quite common to use feed mixtures (complete or supplementary compound feed) produced by the feed industry. Cereal and legume grains are sold to the mills, which then produce concentrate feed. In Germany, for example, nearly 90 percent of the feed for broilers consists of mixtures and for layers, about 50 percent.

The use of feed mixtures has to be considered when looking at the farm-level share of home-grown and purchased feeding components in poultry diets.

It should be noted that the calculations of protein and amino acid consumption, in these tables, are based on the total calculated annual feed demand in dry matter, as shown in the tables “Concentrate feed, energy and protein demand” (example Austria: Table 22) and not on the actual amount of feed used in 2011, which is unknown.

As a result of the aforementioned broad assumptions, it is therefore not possible to make definite statements regarding an undersupply or oversupply of energy, protein, or amino acids when comparing the results of these feeding practice tables with those of the feed demand tables.

On the other hand, these feeding practice tables can give hints as to which crops and secondary feed products are probably not produced sufficiently in the country and have to be imported. (See also the feedstuff production tables of each country; for example Austria Table 21).

Also, be aware that only commonly used components are listed, and therefore the sum of the components does not always equal 100 percent. On the other hand, it is possible for the total feed to exceed 100 percent, for example, if experts state a range of percentages for the use of a feeding component.

7.1.2 Austria

For Austria the data were provided by Lisa Baldinger and Werner Zollitsch of the University of Natural Resources and Life Sciences in Vienna BOKU, who compiled datasets from official statistics and information from experts from feed mills and an organic farmers' association.

The following information was provided:

- Data on the total organic area (Area [ha], share estimate animal feed [%], Area EF [ha]) (Grüner Bericht 2012; estimate % feed: Harald Grafl, Franz Traudtner (Bio Austria), own estimations Werner Zollitsch (Boku Vienna), Peter Binggl (feed mill Vitacorn), Martin Fischl (Landwirtschaftskammer Niederösterreich))
- Data on the total organic production ([yield]) (yield is an average from literature data)
- Total estimated production volume animal feed ([mt]) (calculation from yield and area estimated feed: Werner Zollitsch and Lisa Baldinger (BOKU Vienna))
- Data on livestock numbers (Grüner Bericht 2012;)
- Further Info on pigs and poultry like average slaughter weight (estimations by: Sonja Wlcek (Bio Austria), Werner Zollitsch (Boku Vienna), Max Gala (Arge Huhn&Co), Werner Hagmüller (LFZ Raumberg-Gumpenstein))
- Feeding practices for pigs laying hens and broilers (estimations by: Sonja Wlcek and Harald Grafl (Bio Austria), Werner Zollitsch (Boku Vienna))

According to the estimations, about 162'000 metric tons of concentrate feed on dry matter basis (DM) are needed to feed the organic animals in Austria. The Austrian organic farmers are able to produce about 143'000 metric tons. This results in a self-sufficiency rate for concentrate feed (DM) of 85 percent (Figure 29). When looking at the supply situation for crude protein (CP), the self-sufficiency rate is at around 75 percent, a bit lower. Regarding own production capacity, Austria is placed in the upper mid-range compared to the other evaluated countries.

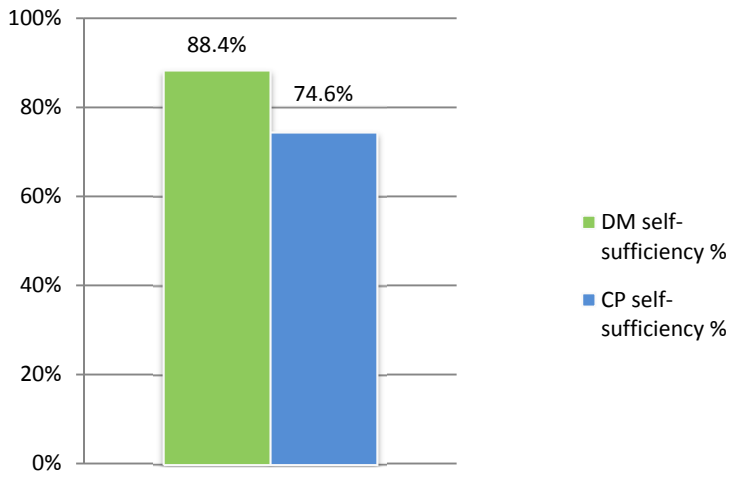


Figure 29: Austria: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: FiBL calculation based on data provided Zollitsch and Baldinger

As shown in Figure 29, the self-sufficiency in crude protein is lower than the self-sufficiency in concentrate feed. This indicates that, in particular, crops with high protein content have to be imported. This applies especially to crops and secondary feed products with a good source of methionine and cysteine, the sulphur containing amino acids (see Figure 30).

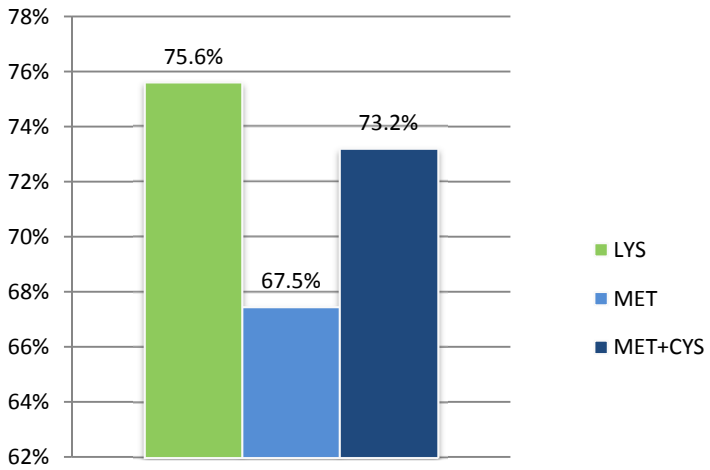


Figure 30: Austria: Self-sufficiency rate for amino acids 2011

Source: FiBL calculation based on data provided Zollitsch and Baldinger

Figure 31 shows the proportional amount of the total feed demand for the different species. Bovine animals account for the largest share of feed (64 percent), followed by poultry (21 percent) and pigs (15 percent).

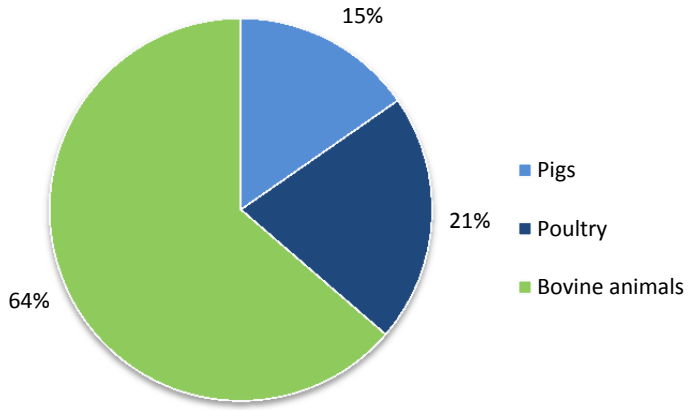


Figure 31: Austria: Demand (%) for concentrate feed (DM) of the different species 2011

Source: FiBL calculation based on data provided Zollitsch and Baldinger

A similar picture with a slight shift of relations emerges when looking at Figure 32, which describes the demand for crude protein of the respective species. Still, bovine animals have the highest demand (55 percent), but less compared to their demand for concentrate feed. The demand for crude protein for poultry and pigs, by contrast, is higher (26 percent and 19 percent, respectively) than for concentrate feed (DM).

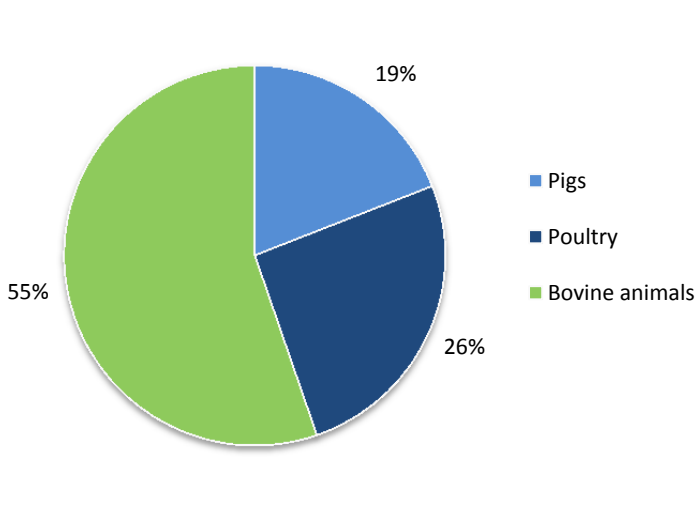


Figure 32: Austria: Demand for crude protein by species in organic agriculture 2011

Source: FiBL calculation based on data provided Zollitsch and Baldinger

Probably due to its geographic circumstances, which restrict extended crop cultivation, the number of bovine animals is relatively high (Table 19). In the mountainous regions, cattle breeds that are adapted to more extensive management systems and therefore show lower feeding requirements are still prevalent. This is reflected by the fact that for dairy cows the calculations regarding feed demands per animal and indicator were lower compared to the dairy and suckler cows' demand in other observed countries, as shown in Table 20. Only in Switzerland, which has similar production conditions to Austria, was the concentrate feed demand for dairy cows lower.

Table 19: Austria: Number of organic animals 2011

Animal Species	Category	Indicator	No
Bovine animals	Dairy cows	Animals [heads]	94'149
	Suckler cows	Animals [heads]	85'002
Pigs	Breeding sows	Animals, places [no]	4'000
		Animals, replacement rate [percent]	29
	Fattening pigs	Animals, slaughter age [days]	220
		Animals, slaughter weight [kg]	125
		Animals, slaughtered [no]	62'000
	Piglets	Animals, piglets weaned per sow/year [no]	16.5
	Pigs, no details	Animals [heads]	3'556
Poultry	Broilers	Animals, slaughter age [days]	56
		Animals, slaughter weight [kg]	2.1
		Animals, slaughtered [no]	1550'000
	Laying hens	Animals, duration laying period [days]	360
		Animals, places [no]	550'000
	Rearing pullets	Animals, places [no]	200'000

Source: Zollitsch and Baldinger based on national sources

Table 20: Austria: Total need of concentrate feed, protein and amino acid per animal species and indicator 2011

Animal Species	Category	Indicator	Total feed DM [kg]	Total ME [MJ]	Total crude protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met + Cys [kg]
Bovine[8]	Dairy cows*	per head and year	883	13622	111	3.74	1.83	4.42
	Suckler cows**	per LSU and year	294	4540	37	1.25	0.61	1.47
Pigs	Breeding sows	per litter	671	8330	110	5.13	1.88	3.74
	Fattening pigs	per number slaughtered	280	4160	52	2.63	0.78	1.55
	Gilts	per head	254	3536	39	2.33	0.75	1.49
	Weaners	per head	27	392	5.3	0.36	0.12	0.23
Poultry	Broilers	per number slaughtered	4.8	69	1.1	0.05	0.02	0.04
	Laying hens	per place and year	41.8	477	6.9	0.30	0.14	0.27
	Rearing pullets	per head	6.8	80	1.2	0.06	0.03	0.05

Source: FiBL calculations based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand)

* Dairy cows: 15% concentrates (protein and energy supplements)
** Suckler cows: 5% concentrates (protein and energy supplements)

Maize and triticale are the most widely produced organic crops for animal feed in Austria. With almost 4'000 metric tons of organic soybean production, Austria plays an important role. Only France produces more soybeans (13'500 metric tons).

Table 21: Austria: Estimated concentrate feed production 2011

Crop	Production EF [mt]	Production DM [mt]	Gross Energy [GJ]	ME pigs [GJ]	ME poultry [GJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley	22'149	19'269	348'772	278'401	254'161	1'904'856	68'955	44'222	31'611	75'834
Beans, field	9'467	8'236	157'725	118'128	96'529	2'437'942	147'924	30'309	20'261	50'571
Lupine	93	81	1'688	1'202	708	28'929	1'336	382	184	566
Maize, grain	42'988	37'400	689'654	597'082	596'903	3'061'370	89'012	75'342	63'580	138'922
Mixed cereal grains	5'628	4'896	89'163	71'636		503'591	16'668	12'806	7'978	20'785
Mixed cereals	3'654	3'179	57'889			326'958	10'822	8'314	5'180	13'494
Oats	5'106	4'442	83'555	57'185	53'438	450'823	16'915	13'215	7'174	20'389
Peas, field	2'280	1'984	37'073	30'754	25'529	451'467	32'531	7'140	4'344	11'485
Protein crops, other	771									
Rye	7'758	6'749	120'539	104'185	82'677	648'252	23'176	16'751	9'925	26'676
Soybeans	5'932	5'338	123'371			2'172'745	134'315	33'952	30'696	64'649
Spelt	2'132	1'855	34'166	21'795		215'523	5'849	5'250	3'185	8'435
Triticale	33'484	29'131	522'903	453'047	418'031	3'013'465	107'217	77'255	52'742	129'997
Wheat, soft, animal feed	23'639	20'566	371'834	324'186	303'554	2'370'439	57'513	55'764	36'885	92'650
Total	165'080	143'127	2'638'333	2'057'601	1'831'529	17'586'360	712'234	380'707	273'745	654'453

Source: Zollitsch and Baldinger based on national sources
*Production EF: Estimated production of feed

[8] Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via concentrate feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

As seen in Table 22 and Table 23, most of the total concentrate feed is needed for bovine animals (103'000 metric tons). About a third of the feed demand is for poultry (34'000 metric tons). The demand of pigs is about 25'000 metric tons. When looking at the crude protein and amino acid demand, relations are shifting, but bovine animals still have the biggest demand, followed by poultry and pigs (Table 23).

Table 22: Austria: Concentrate feed, energy and crude protein demand 2011

Animal Species	Category	Livestock Indicator	heads/no	Feed DM per head/no [kg]	Total feed DM [mt]	Total ME [MJ]	Crude protein [mt]
Pigs	Breeding sows	Litters [no]	8'000	671.00	5'368	66'640'000	880
	Fattening pigs	Animals, slaughtered [no]	62'000	280.00	17'360	257'920'000	3'224
	Gilts*	Animals [heads]	1'160	254.35	295	4'102'618	46
	Weaners**	Animals [heads]	65'720	27.38	1'799	25'806'272	346
Pigs total			136'880	1'232.72	24'822	354'468'891	4'496
Poultry	Broilers	Animals, slaughtered [no]	1'550'000	4.87	7'549	106'950'000	1'659
	Laying hens	Animals, places [no]	550'000	41.86	23'023	262'460'000	3'808
	Rearing pullets	Animals [heads]	500'000	6.86	3'432	40'155'000	585
Poultry total			2'600'000	53.59	34'004	409'565'000	6'051
Bovine animals* **	Dairy cows	Animals [heads]	94'149	882.75	83'110	1'282'497'678	9'075
	Suckler cows	LSU [no]	68'002	294.00	19'992	308'727'264	2'185
Bovine animals total					103'103	1'591'224'942	13'037
Total			2'899'031	2'463.07	161'928	2'355'258'833	23'584

Source: Zollitsch and Baldinger based on national sources; FiBL calculation of feedstuff demand

* Gilts: calculated from average replacement rate of breeding sows = 29%
** Weaners: calculated from number of slaughtered fattening pigs plus additional 6% for gilts, losses, etc.
*** Bovine animals: only protein and concentrate feed, Dairy cows: 15% of total DM, Suckler cows: 5% of total DM.

Table 23: Austria: Total amino acid demand 2011

Animal Species	Category	Crude Protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Pigs	Breeding sows	880	41'040	15'040	29'920
	Fattening pigs	3'224	163'060	48'484	96'100
	Gilts	46	2'705	871	1'727
	Weaners	346	23'725	7'558	15'247
Pigs total		4'496	230'530	71'953	142'994
Poultry	Broilers	1'659	80'600	29'450	65'100
	Laying hens	3'808	165'550	78'100	145'750
	Rearing pullets	585	29'000	12'500	23'500
Poultry total		6'051	275'150	120'050	234'350
Bovine animals	Dairy cows	10'507	351'835	172'293	416'421
	Suckler cows	2'530	84'730	41'481	100'234
Bovine animals total		13'037	436'565	213'774	516'655
Total		23'584	942'245	405'777	894'000

Source: FiBL calculation of feedstuff demand

According to the rough estimates of the interviewed experts, farmers mainly use home-grown feed components in the feeding rations for fattening pigs (Table 24, Table 25). Barely and triticale account for the largest share of the home-grown and purchased feed (25 percent each). Home-grown beans (7.3 percent) and peas (14.7 percent) are used as a protein source along

with, to a lesser extent, purchased soy cake (6 percent) and potato protein (2 percent). In broiler production, home-grown maize and triticale (each 30 percent) are the prevalent energy components. Home-grown beans and peas (7.5 percent each) as well as purchased beans and peas (7.5 percent each), are the commonly used protein components. Additionally, soy cake (8 percent) and potato protein (5 percent) are purchased.

Table 24: Austria: Feeding practices and derived calculated feed, energy and protein consumption 2011 for fattening pigs, broilers and laying hens (proportions of diets (%) are estimates of main feeding components)

Animal Species	Category	Own or Bought	Crop	Proportion in diet %	DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	CP [kg]
Pigs	Fattening pigs	Own	Barley*	25.0%	4'340	78'554'000	62'704'320		429'031
			Beans, field	7.3%	1'267	24'268'412	18'175'837		375'115
			Peas, field	14.7%	2'552	47'695'385	39'564'968		580'817
			Triticale*	25.0%	4'340	77'903'000	67'495'680		448'951
		Bought	Barley*	10.0%	1'736	31'421'600	25'081'728		171'612
			Potato protein	2.0%	347	7'943'936	6'159'606		289'391
			Soybean cake	6.0%	1'042	21'592'368	16'468'946		507'780
			Triticale*	10.0%	1'736	31'161'200	26'998'272		179'581
	Fattening pigs total			100.0%	17'360	320'539'901	262'649'356		2'982'278
Poultry	Broilers	Own	Beans, field	7.5%	566	10'841'533		6'635'132	167'577
			Maize, grain	30.0%	2'265	41'758'302		36'142'218	185'365
			Peas, field	7.5%	566	10'581'110		7'286'190	128'853
			Wheat, soft, animal feed	30.0%	2'265	40'943'064		33'424'758	261'012
		Bought	Beans, field	7.5%	566	10'841'533		6'635'132	167'577
			Peas, field	7.5%	566	10'581'110		7'286'190	128'853
			Potato protein	5.0%	377	8'635'484		6'038'800	314'584
			Soy cake	8.0%	604	12'518'432		6'660'796	294'392
	Broilers total			103.0%	7'775	146'700'568		110'109'215	1'648'211
	Laying hens	Own	Wheat, soft, animal feed	10.0%	2'302	41'625'584		33'981'948	265'363
		Bought**	Beans, field	5.0%	1'151	22'044'523		13'491'478	340'740
			Maize, grain	17.0%	3'914	72'172'500		62'466'004	320'373
			Peas, field	5.0%	1'151	21'514'994		14'815'301	262'002
			Potato protein	4.4%	1'013	23'177'715		16'208'192	844'346
			Soybeans	7.0%	1'612	37'244'307			655'925
			Triticale	20.0%	4'605	82'652'570		66'076'010	476'323
			Wheat, soft, animal feed	10.0%	2'302	41'625'584		33'981'948	265'363
	Laying hens total**			78.4%	18'050	342'057'776		241'020'880	3'430'435

Source for percentage in ration: Estimations by W. Zollitsch (Boku Vienna) and S. Wlcek (Bio Austria) based on national sources

Source for other data: FiBL calculation of feedstuff consumption based on data from Zollitsch and Baldinger

* If own cereals have very good quality they are sold for human consumption and cheaper cereals for feeding is purchased

** 80 percent purchased feed: exemplary feed formulation; each mill has their own formulations.

Table 25: Austria: Feeding practices and derived calculated amino acid consumption 2011 for fattening pigs, broilers and laying hens

Animal Species	Category	Own or Bought	Crop	CP [kg]	LYS [kg]	MET [kg]	CYS [kg]	MET + CYS [kg]
Pigs	Fattening pigs	Own	Barley	429'031	15'531	7'120	9'960	17'080
			Beans, field	375'115	22'760	3'118	4'664	7'781
			Peas, field	580'817	41'851	5'589	9'187	14'776
			Triticale	448'951	15'973	7'858	11'510	19'367
		Bought	Barley	171'612	6'212	2'848	3'984	6'832
			Potato protein	289'391	21'346	6'486	4'347	10'833
			Soy cake	507'780	31'258	7'145	7'906	15'051
			Triticale	179'581	6'389	3'143	4'604	7'747
	Fattening pigs total			2'982'278	161'322	43'306	56'161	99'467
Poultry	Broilers	Own	Beans, field	167'577	10'168	1'393	2'083	3'476
			Maize, grain	185'365	5'390	3'850	4'562	8'412
			Peas, field	128'853	9'285	1'240	2'038	3'278
			Wheat, soft, animal feed	261'012	6'333	4'061	6'140	10'202
		Bought	Beans, field	167'577	10'168	1'393	2'083	3'476
			Peas, field	128'853	9'285	1'240	2'038	3'278
			Potato protein	314'584	23'204	7'050	4'725	11'776
			Soy cake	294'392	18'122	4'143	4'583	8'726
	Broilers total			1'648'211	91'954	24'369	28'254	52'623
	Laying hens	Own	Wheat, soft, animal feed	265'363	6'438	4'129	6'243	10'372
		Bought	Beans, field	340'740	20'675	2'832	4'236	7'068
			Maize, grain	320'373	9'315	6'654	7'885	14'538
			Peas, field	262'002	18'879	2'521	4'144	6'665
			Potato protein	844'346	62'280	18'923	12'683	31'606
			Soybeans	655'925	40'548	9'267	10'250	19'517
			Triticale	476'323	16'947	8'337	12'211	20'548
			Wheat, soft, animal feed	265'363	6'438	4'129	6'243	10'372
	Laying hens total			3'430'435	181'521	56'791	63'894	120'686

Source for percentage in ration: Estimations by W. Zollitsch (Boku Vienna) and S. Wlcek (Bio Austria) based on national sources

Source for other data: FiBL calculation of feedstuff consumption based on data Zollitsch and Baldinger

7.1.3 Denmark

For Denmark, data was provided by Hermansen and Horsted of Aarhus University.

The following information was provided:

- Data on the total organic area (Area [ha]; Area EF [ha]; Area, share feedstuffs [%]) (Eurostat, estimations share feedstuffs J. Hermansen & K. Horsted)
- Data on the total organic production ([yield])
- Total estimated production volume animal feed (production EF [mt]) (calculation J. Hermansen & K. Horsted)
- Data on Livestock (Eurostat)
- Feeding practices for pigs, laying hens and broilers (J. Hermansen & K. Horsted from national sources)

On dry matter (DM) basis, about 174'000 metric tons of concentrate feed are needed to supply organic animal farming in Denmark, and Danish organic farm production is about 126'000 metric tons. In Denmark, the self-sufficiency rate for organic concentrate feed components averages around 65 percent (Table 35). The self-sufficiency rate for crude protein reaches around 50 percent.

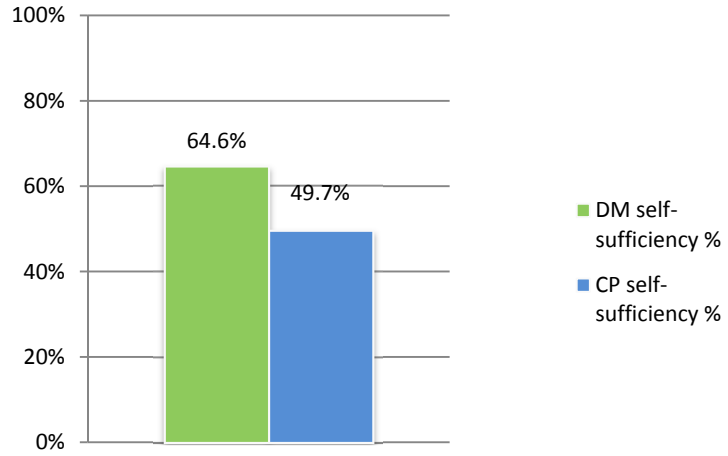


Figure 33: Denmark: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: Hermansen and Horsted, based on national data sources, calculations by FiBL

In accordance with the supply situation for crude protein, the self-sufficiency rate for amino acids is between 40.6 percent and 50 percent (Figure 34: Denmark: Self-sufficiency rate for amino acids).

As can be seen in Figure 33, the self-sufficiency of crude protein is lower than the self-sufficiency of concentrate feed. This indicates that, in particular, crops and secondary feed products with high protein content have to be imported.

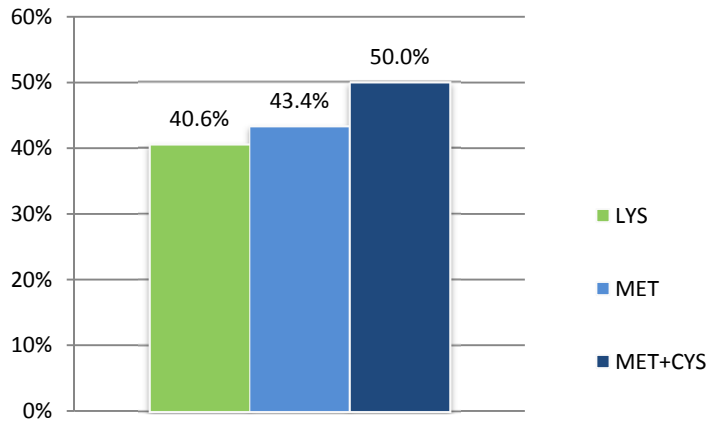


Figure 34: Denmark: Self-sufficiency rate for amino acids 2011

Source: Hermansen and Horsted, based on national data sources, calculations by FiBL

Figure 35 shows the proportional demand for concentrate feed by the different species. Bovine animals account for the largest share of feed (59 percent). In contrast to the other observed countries, the demand of pigs (27 percent) exceeds that of poultry (14 percent).

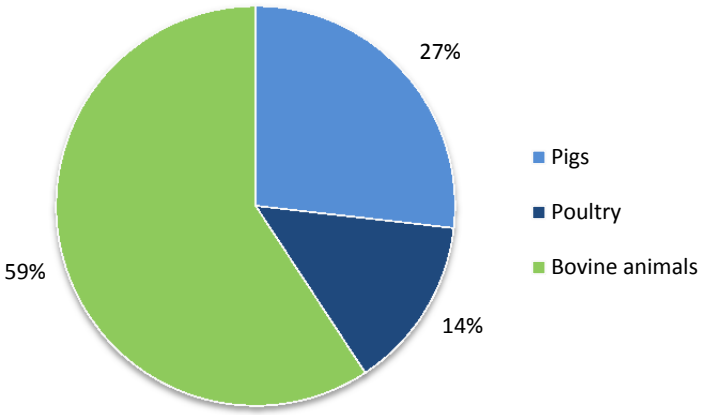


Figure 35: Denmark: Demand (%) for concentrate feed (DM) of the different species 2011

Source: Hermansen and Horsted, based on national data sources, calculations by FiBL

A similar picture with a slight shift of relations emerges from Figure 44, which describes the demand for crude protein of the respective species. Again, bovine animals have the greatest requirement (53 percent). The demand for crude protein of pigs and poultry amounts to 31 percent and 16 percent, respectively.

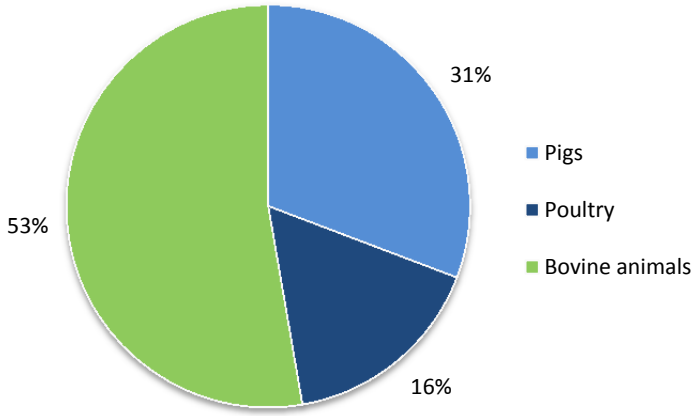


Figure 36: Denmark: Amount of the demand for crude protein of the different species 2011

Source: Hermansen and Horsted, based on national data sources, calculations by FiBL

Table 26: Denmark: Number of organic animals 2011

Animal Species	Category	Indicator	No
Bovine animals	Bovine animals for meat production	Animals [heads]	68'024
	Bovine animals, other	Animals [heads]	38'597
	Dairy cows	Animals [heads]	63'158
	Suckler cows	Animals [heads]	8'349
Other livestock	Other livestock, no details	Animals [heads]	28
Pigs	Breeding sows	Animals [heads]	6'421
	Fattening pigs	Animals [heads]	85'626
	Pigs, other	Animals [heads]	79'182
Poultry	Broilers	Animals [heads]	248'055
	Laying hens	Animals [heads]	550'178
	Poultry, other	Animals [heads]	109'984
	Rearing pullets	Animals [heads]	428'814

Source: Hermansen and Horsted, based on national data sources

The calculated requirement of feed and protein per dairy cow is relatively high due to high input dairy production systems and highly demanding dairy cows (Table 27). Compared to other countries, fattening pigs in Denmark have a lower age and weight at slaughter (~170 days instead of ~220 days and ~100 kg instead of about 120 kg). Due to this fact we assumed a lower total feed, protein and amino acid demand per individual.

Table 27: Denmark: Total need of concentrate feed, protein and amino acid per animal species and indicator 2011

Animal Species	Category	Indicator	Total feed DM [kg]	Total ME [MJ]	Total Crude Protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met + Cys [kg]
Bovine[9]	Dairy cows*	per head and year	1766	27243	223	7.48	3.66	8.85
	Suckler cows**	per LSU and year	588	9081	74	2.49	1.22	2.95
Pigs	Breeding sows	per litter	671	8330	110	5.13	1.88	3.74
	Fattening pigs	per number slaughtered	235	3366	38	2.24	0.72	1.43
	Gilts	per head	254	3537	40	2.33	0.75	1.49
	Weaners	per head	27	393	5.3	0.36	0.12	0.23
Poultry	Broilers	per number slaughtered	4.9	69	1.1	0.05	0.02	0.04
	Laying hens	per place and year	41.9	477	6.9	0.30	0.14	0.27
	Rearing pullets	per head	6.9	80	1.2	0.06	0.03	0.05

Source: FiBL calculations based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand) and inputs from Hermansen and Horsted

* Dairy cows: about 30% protein and energy feed, only these 30% are listed in the table (includes cereals, legume seeds and oil seed cakes)

** Suckler cows: 10% protein and concentrate feed

With around 12'000 hectares in 2010 and 2011 and an estimated production of almost 50'000 metric tons, barley is the most cultivated cereal grain in organic agriculture in Denmark. In terms of surface area, barley is followed by oats and rye, but when looking at the estimated feed production, winter wheat comes right after barley. With almost 43'000 metric tons, barley is followed by wheat (Table 28). Peas and beans are the prevalent protein crops with about 1'900 and 1'500 metric tons produced (DM), respectively.

Table 28: Denmark: Estimated concentrate feed production 2011

Crop	Production EF [mt]*	Production DM [mt]	Gross Energy [MJ]	ME pigs [GJ]	ME poultry [GJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley	48'984	42'616	771'351	615'717	562'106	4'212'813	152'502	97'804	69'912	167'716
Beans, field	1'673	1'456	27'873	20'876	17'059	430'831	26'141	5'356	3'581	8'937
Lupine	790	687	14'385	10'247	6'034	246'535	11'389	3'258	1'567	4'825
Oats	13'083	11'382	214'099	146'530	136'928	1'155'181	43'343	33'862	18'382	52'244
Peas, field	2'210	1'923	35'935	29'810	24'745	437'607	31'532	6'922	4'211	11'132
Rye	11'460	9'970	178'068	153'908	122'135	957'638	34'238	24'746	14'661	39'407
Triticale	9'000	7'830	140'549	121'772	112'361	809'974	28'818	20'765	14'176	34'941
Wheat, soft, animal feed	40'672	35'385	639'754	557'775	522'277	4'078'434	98'953	95'945	63'462	159'408
Cereals, no details	16'840	14'651	265'179			1'448'305	52'303	33'624	24'035	57'658
Total	144'712	125'899	2287194	1'656'634	1'503'645	13'777'316	479'219	322'282	213'987	536'269

Source: FiBL calculations based on Hermansen and Horsted

*Production EF: Estimated production of feed

[9] Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via concentrate feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

Table 29 and Table 30 present the total demand of nutritive requirements from concentrate feed (DM), crude protein, energy, and amino acids. Most concentrate feed (DM) is needed for bovine animals (115'000 metric tons), followed by the amount for pigs (31'000 metric tons) and poultry (27'000 metric tons). When the crude protein and amino acid demand are considered, the exact relationships change, but bovine animals still have the biggest demand, followed by pigs and poultry. For methionine, the demand of poultry exceeds that of pigs.

Table 29: Denmark: Concentrate feed, energy and crude protein demand 2011

Animal Species	Category	Livestock Indicator	heads/no	feed DM per head/no [kg]	Total feed DM [mt]	Total ME [MJ]	Crude Protein [mt]
Pigs	Breeding sows	Litters [no]	12'842	671.00	8'617	106'973'860	1'413
	Fattening pigs	Animals, slaughtered [no]	171'252	235.00	40'244	576'434'232	6'508
	Gilts	Animals [heads]	3'146	254.35	800	11'127'610	125
	Weaners	Animals [heads]	90'764	27.38	2'485	35'640'127	477
Pigs total					52'146	730'175'829	8'523
Poultry	Broilers	Animals, slaughtered [no]	248'055	4.87	1'208	17'115'795	265
	Laying hens	Animals, places [no]	550'178	41.86	23'030	262'544'942	3'809
	Rearing pullets	Animals [heads]	428'814	6.86	2'943	34'438'052	501
Poultry total					27'182	314'098'789	4'576
Bovine animals	Dairy cows	Animals [heads]	63'158	1'765.50	111'505	1'720'613'394	14'101
	Suckler cows	LSU [no]	6'679	588.00	3'927	60'653'815	429
Bovine animals total			69'837	2'353.50	115'433	1'781'267'209	14'598
Total					194'761	2'825'541'827	27'696

Source: FiBL calculations based on Hermansen and Horsted

Table 30: Denmark: Total amino acid demand 2011

Animal Species	Category	Crude Protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Pigs	Breeding sows	1'413	65'879	24'143	48'029
	Fattening pigs	6'508	383'604	123'644	244'890
	Gilts	125	7'337	2'363	4'685
	Weaners	477	32'766	10'438	21'057
Pigs total		8'523	489'587	160'588	318'661
Poultry	Broilers	265	12'899	4'713	10'418
	Laying hens	3'809	165'604	78'125	145'797
	Rearing pullets	501	24'871	10'720	20'154
Poultry total		4'576	203'374	93'559	176'370
Bovine animals	Dairy cows	14'101	472'106	231'158	558'696
	Suckler cows	497	16'645	8'149	19'697
Bovine animals total		14'598	488'751	239'307	578'393
Total		27'696	1'181'711	493'453	1'073'424

Source: FiBL calculations based on Hermansen and Horsted

According to the rough estimates by the experts, the majority of feeding components for fattening pigs are home-grown (Table 31 and Table 32). Wheat accounts for about 20 percent and the largest share of home-grown feed, soy cake with also about 20 percent accounts for the largest share of purchased feed. For poultry, only purchased feed is used. Wheat (44 percent) and to a lesser extent maize (10 to 20 percent) are used as energy feed. Soy cake (13 to 20 percent) is used solely as protein feed.

Table 31: Denmark: Feeding practices and derived calculated feed, energy and protein consumption 2011 for fattening pigs, broilers and laying hens (proportions of diets (%) are estimates of main feeding components)

Animal Species	Own or Bought	Crop	Share in Feed %	DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	CP [kg]
Fattening pigs	Own	Oats	13.0%	5'232	98'409'191	67'351'439		530'970
		Triticale	13.0%	5'232	93'909'887	81'364'154		541'198
		Wheat, soft, animal feed	20.0%	8'049	145'523'100	126'875'538		927'710
	Bought	Dried grass meal	10.0%	4'024				
		Potato protein	5.0%	2'012	46'039'388	35'698'233		1'677'178
		Soy cake	20.0%	8'049	166'852'536	127'261'882		3'923'811
	Fattening pigs total		81.0%	32'598	550'734'102	438'551'246		7'600'868
Broilers	Bought	Maize, grain	20.0%	242	4'455'207		3'856'025	19'777
		Soy cake	20.0%	242	5'008'483		2'664'909	117'783
		Wheat, soft, animal feed	44.0%	532	9'610'103		7'845'416	61'264
	Broilers total		84.0%	1'015	19'073'793		14'366'350	198'824
Laying hens	Bought	Maize, grain	10.0%	2'303	42'468'152		36'756'600	188'516
		Soy cake	13.0%	2'994	62'064'763		33'023'364	1'459'555
		Wheat, soft, animal feed	44.0%	10'133	183'211'844		149'568'961	1'167'976
	Laying hens total		67.0%	15'430	287'744'759		219'348'925	2'816'046

Source: FiBL calculations based on Hermansen and Horsted

Table 32: Denmark: Feeding practices and derived calculated amino acid consumption 2011 for fattening pigs, broilers and laying hens

Animal Species	Own or bought	Crop	CP [kg]	LYS [kg]	MET [kg]	CYS [kg]	MET + CYS [kg]
Fattening pigs	Own	Oats	530'970	19'923	8'449	15'564	24'014
		Triticale	541'198	19'255	9'472	13'875	23'347
		Wheat, soft, animal feed	927'710	22'509	14'436	21'824	36'260
	Bought	Dried grass meal					
		Potato protein	1'677'178	123'711	37'588	25'193	62'781
		Soy cake	3'923'811	241'546	55'215	61'091	116'306
	Fattening pigs total		7'600'868	426'943	125'160	137'547	262'707
Broilers	Bought	Maize, grain	19'777	575	411	487	897
		Soy cake	117'783	7'251	1'657	1'834	3'491
		Wheat, soft, animal feed	61'264	1'486	953	1'441	2'395
	Broilers total		198'824	9'312	3'021	3'762	6'783
Laying hens	Bought	Maize, grain	188'516	5'481	3'915	4'639	8'555
		Soy cake	1'459'555	89'849	20'539	22'724	43'263
		Wheat, soft, animal feed	1'167'976	28'338	18'174	27'477	45'651
	Laying hens total		2'816'046	123'668	42'628	54'840	97'468

Source: FiBL calculations based on Hermansen and Horsted

7.1.4 Finland

Information was provided by Liisa Voutila of MTT Agrifood Research, Animal Production Research Unit, Finland, based on national sources and estimates.

The following information was provided:

- Data on the total estimated organic area used for animal feed (Area; EF [ha]) (Agricultural Statistics (MATILDA), VYR)
- Data on organic production ([yield]) (Agricultural Statistics (MATILDA))
- Total estimated production volume animal feed (EF,[mt]) (Agricultural Statistics (MATILDA))
- Data on Livestock (Evira, ProAgria, Finnish Poultry Association)
- Feeding practices for pigs and laying hens (ProAgria, Agrimarket.Ltd., organic pig farms, Finnish Poultry Association)

Apart from Lithuania, Finland is the only country, within the ICOPP project, in which the supply of concentrate feed (DM) and the availability of crude protein exceed demand (Figure 37). Farmers are able to produce about 26'000 metric tons on a dry matter basis, resulting in a self-sufficiency rate for concentrate feed (DM) of 125 percent (Figure 37). For crude protein (CP), the self-sufficiency rate is around 109 percent.

However, the self-sufficiency rate of 125 percent for concentrate feed in dry matter shows a distorted picture, since about 46 percent of Finland's feed production of 26'000 metric tons (DM) consists of oats. For a balanced animal diet, this means that in reality protein feeds like soybeans and also other energy crops like wheat have to be imported from other countries (see also Table 35 on feed production and Table 38 on feeding practice).

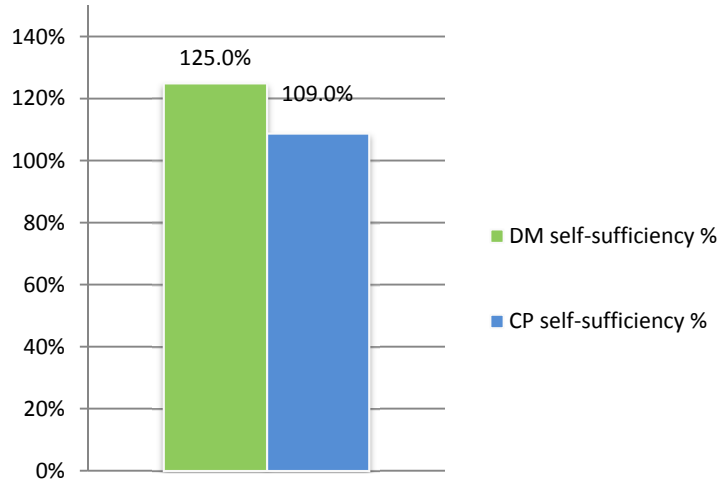


Figure 37: Finland: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: FiBL calculation based on Voutila

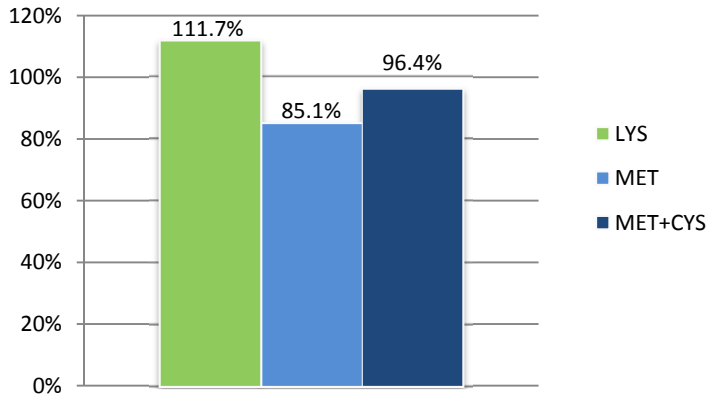


Figure 38: Finland: Self-sufficiency rate for amino acids 2011

Source: FiBL calculation based on Voutila

Table 33 shows the demand for concentrate feed per species. Bovine animals require by far the most concentrate feed (63 percent), followed by poultry (26 percent) and pigs (11 percent, Figure 39).

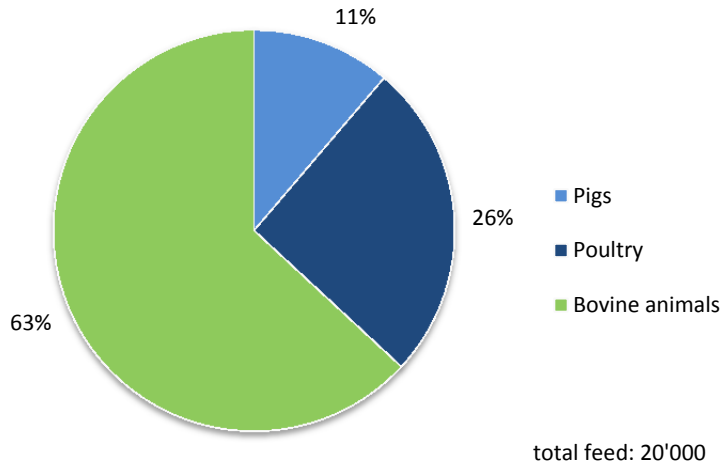


Figure 39: Finland: Demand (%) for concentrate feed (DM) of the different species 2011

Source: FiBL calculation based on Voutila

A similar picture with a slight shift of relations emerges from Figure 35, which shows the demand for crude protein of the respective species. Bovine animals have still the greatest need (59 percent). The demand for crude protein of poultry and pigs amounts to 28 percent and 13 percent, respectively.

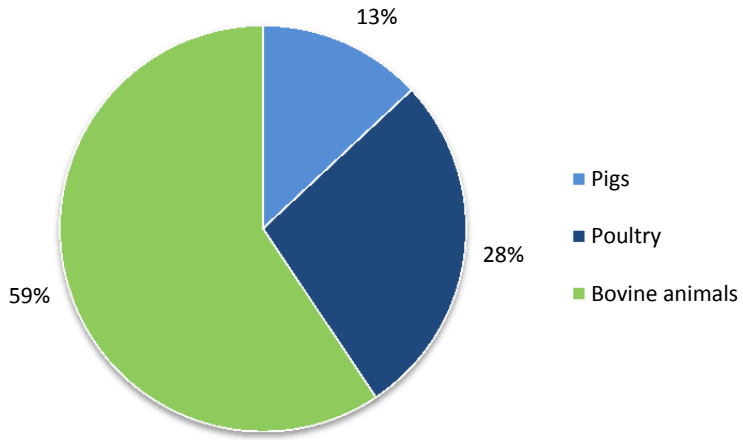


Figure 40: Finland: Demand (%) for crude protein of the different species 2011

Source: FiBL calculation based on Voutila

The reason for the high self-sufficiency rates is the low number of animals in all categories (Table 33 and Table 36) in relation to Finland's feed production. With only about 6'000 cows, Finland has the lowest number of bovine animals compared with the other countries. Sweden, for example, has about 44'000 and Austria about 94'000 cows. With about 2'400 places for fattening pigs, resulting in approximately 5'300 slaughtered pigs per year and about 112'661 places for laying hens, Finland together with Lithuania has the lowest number of pigs and poultry. It should be noted that broilers were reported only for one experimental farm.

Table 33: Finland: Number of organic animals 2011

Animal Species	Category	Indicator	No
Bovine animals	Bovine animals aged between 1 and 2 years	Animals [heads]	10'612
	Bovine animals less than 1 year old	Animals [heads]	11'152
	Dairy cows	Animals [heads]	5'776
	Bovine animals of 2 years and over, other	Animals [heads]	13'051
Pigs	Breeding sows	Animals, places [no]	518
	Fattening pigs	Animals, places [no]	2'407
	Pigs, other	Animals, places [no]	11
Poultry	Broilers*	Animals, slaughtered [no]	301
	Laying hens	Animals [heads]	112'661
	Turkeys	Animals, slaughtered [no]	2'000

Source: Voutila based on national data sources

The feed, protein, and amino acid demand per animal and type conforms to the demand in the other mentioned European countries (Table 34). Only dairy cows represent an exception. The need for concentrate feed (2275 kg DM) and crude protein (330 kg) per cow and year is, together with the assumed demand data for the animals in Sweden, the highest within the observed countries, probably due to the focus on high-input dairy production systems and highly demanding dairy breeds.

Table 34: Finland: Total need of concentrate feed, protein and amino acid per animal species and indicator 2011

Animal Species	Category	Indicator	Total feed DM [kg]	Total ME [MJ]	Total DE [MJ]	Total Crude Protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met+Cys [kg]
Bovine[10]	Dairy cows*	per head and year	2'275	33'594		330	14.44	5.51	14.40
Pigs	Breeding sows**	per litter	671	8'330	8'680	110	5.13	1.88	3.74
	Fattening pigs	per number slaughtered	280	4'160	4'333	52	2.63	0.78	1.55
	Gilts	per head	254	3'536	3'684	39	2.33	0.75	1.49
	Weaners	per head	27	392	409	5.2	0.36	0.12	0.23
Poultry	Broilers	per number slaughtered	4.8	69		1.1	0.05	0.02	0.04
	Laying hens	per place and year	41.8	477		6.9	0.30	0.14	0.27
	Rearing pullets	per head	6.8	80		1.1	0.06	0.03	0.05

Source: FiBL calculations based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand)

* Dairy cows: 20% protein and concentrate feed
**Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between

In contrast to the countries in central Europe, where wheat, maize and triticale are the most commonly produced energy crops; oat production plays a major role in Finland (12'000 metric tons), followed by barley (6'500 metric tons) (Table 35). Field beans and rape are the main cultivated protein and oilseed crops.

Table 35: Finland: Estimated concentrate feed production 2011

Crop	Production EF [mt]*	Production DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley	7'500	6'525	118'103	94'273	86'065	645'029	23'350	14'974	10'704	25'679
Beans, field	3'000	2'610	49'982	37'434	30'589	772'560	46'876	9'604	6'421	16'025
Oats	13'800	12'006	225'833	154'560	144'432	1'218'489	45'719	35'717	19'390	55'108
Peas, field	1'700	1'479	27'643	22'930	19'035	336'620	24'256	5'324	3'239	8'563
Rye	100	87	1'554	1'343	1'066	8'356	299	215	128	344
Wheat, soft, animal feed	3'100	2'697	48'762	42'513	39'808	310'856	7'542	7'312	4'837	12'150
Soy cake	205	181	3'747	2'858	1'994	88'117	5'424	1'371	1'240	2'612
Rape cake	420	382	7'885	5'467	3'952	106'720	6'575	2'862	2'105	4'967
Linseed cake/expeller	60	54		615		16'405	636	313	303	616
Total	29'885	26'021	483507	361'994	326'940	3'503'152	160'676	77'697	48'367	126'065

Source: FiBL calculations based on Voutila based on national sources
*Production EF: Estimated production of feed

As seen in Table 36, most concentrate feed and protein is needed for bovine animals (13'000, and 1'900 metric tons respectively). Less than half of the feed and protein amount is required

[10] Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

for poultry, and again slightly less than half of poultry's demand is required for pigs. When looking at the amino acid demand, relations shift slightly, but bovine animals still have the highest demand, followed by poultry and pigs (Table 37).

Table 36: Finland: Concentrate feed, energy and crude protein demand 2011

Animal Species	Category	Indicator	heads/no	Feed DM per head/no [kg]	Total feed DM [mt]	Total ME [MJ]	Crude Protein [mt]
Pigs	Breeding sows*	Litters [no]	984	671.00	660	8'198'386	108
	Fattening pigs	Animals, slaughtered [no]	5'280	280.00	1'478	21'964'800	275
	Gilts**	Animals [heads]	181	254.35	46	641'211	7
	Weaners***	Animals [heads]	5'597	27.38	153	2'197'695	29
Pigs total				1'232.72	2'338	33'002'092	419
Poultry	Broilers	Animals, slaughtered [no]	301	4.87	1	20'769	0.3
	Laying hens	Animals, places [no]	112'661	41.86	4'716	53'761'829	780
	Rearing pullets	Animals [heads]	90'129	6.86	619	7'238'244	105
Poultry total			203'091	53.59	5'336	61'020'842	886
Bovine animals ****	Dairy cows	Animals [heads]	5'776	2'275.00	13'140	194'038'944	1'907
Bovine animals total			5'776	2'275.00	13'140	194'038'944	1'907
Total					20'815	288'061'879	3'213

Source: FiBL calculations based on Voutila based on national sources
*Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between; 2 litters per year
** Gilts: calculated from average replacement rate of breeding sows = 35%
*** Weaners: calculated from number of slaughtered fattening pig plus additional 6% for gilts, losses, etc.
**** Bovine animals: only protein and energy feed, Dairy cows: approximately 30 % of total DM

Table 37: Finland: Total amino acid demand 2011

Animal Species	Category	Crude Protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Pigs	Breeding sows	108	5'049	1'850	3'681
	Fattening pigs	275	13'886	4'129	8'184
	Gilts	7	423	136	270
	Weaners	29	2'020	644	1'298
Pigs total		419	21'379	6'759	13'433
Poultry	Broilers	0.3	16	6	13
	Laying hens	780	33'911	15'998	29'855
	Rearing pullets	105	5'227	2'253	4'236
Poultry total		886	39'154	18'257	34'104
Bovine animals	Dairy cows	1'907	83'377	31'849	83'169
Bovine animals total		1'907	83'377	31'849	83'169
Total		3'213	143'909	56'865	130'706

Source: FiBL calculations based on Voutila based on national sources

According to rough estimates by experts, feeding components for fattening pigs are mainly home-grown, containing mainly wheat (35 percent), barley (26 percent), and beans (20 percent) (Table 38 and Table 39). Prevalent purchased sources of protein are rapeseed cake (7 percent) and soy cake (6 percent). For laying hens, barley (26 percent) and oats (20 percent), both mainly home-grown, are the dominant energy sources; soy cake (10 percent) and peas (8 percent), both purchased, serve as the main protein sources.

Table 38: Finland: Feeding practices and derived calculated feed, energy and protein consumption 2011 for fattening pigs and laying hens (proportions of diets (%) are estimates of main feeding components)

Animal	Own or	Crop	Share in	DM [mt]	Gross	ME pigs	ME poultry	CP [kg]
Fattening	Own	Barley	26.0%	384	6'957'350	5'553'580		37'998
		Beans, field	20.0%	296	5'662'272	4'240'761		87'521
		Oats	8.0%	118	2'224'696	1'522'586		12'003
		Peas, field	9.0%	133	2'486'817	2'062'900		30'284
		Wheat,	35.0%	517	9'355'315	8'156'510		59'640
	Bought	Peas, field	3.3%	49	911'833	756'397		11'104
		Potato	4.0%	59	1'353'032	1'049'120		49'290
		Rapeseed	7.0%	103	2'134'957	1'480'292		28'896
		Soy cake	6.0%	89	1'838'834	1'402'517		43'243
		Fattening	118.3%	1'749	32'925'106	26'224'663		359'980
Laying	Own	Barley	26.0%	1'226	22'193'446		16'173'014	121'212
		Oats	20.0%	943	17'741'552		11'346'671	95'725
		Wheat,	5.0%	236	4'263'254		3'480'400	27'178
	Bought	Beans, field	5.0%	236	4'515'560		2'763'570	69'797
		Maize	3.6%	170				
		Oats	8.0%	377	7'096'621		4'538'668	38'290
		Peas, field	8.0%	377	7'051'347		4'855'583	85'869
		Rapeseed	2.0%	94	1'945'817		975'267	26'336
		Rapeseed	2.0%	94				
		Soy cake	10.0%	472	9'776'246		5'201'736	229'904
		Laying	89.6%	4'226	74'583'845		49'334'909	694'312

Source: FiBL calculations based on Voutila based on national sources

Table 39: Finland: Feeding practices and derived calculated amino acid consumption 2011 for fattening pigs and laying hens

Animal Species	Own or Bought	Crop	CP [kg]	LYS [kg]	MET [kg]	CYS [kg]	MET + CYS [kg]
Fattening pigs	Own	Barley	37'998	1'376	631	882	1'513
		Beans, field	87'521	5'310	727	1'088	1'815
		Oats	12'003	450	191	352	543
		Peas, field	30'284	2'182	291	479	770
		Wheat, soft, animal feed	59'640	1'447	928	1'403	2'331
	Bought	Peas, field	11'104	800	107	176	282
		Potato protein	49'290	3'636	1'105	740	1'845
		Rapeseed cake	28'896	1'780	570	775	1'345
		Soy cake	43'243	2'662	609	673	1'282
		Fattening pigs total	359'980	19'644	5'158	6'568	11'727
Laying hens	Own	Barley	121'212	4'388	2'012	2'814	4'826
		Oats	95'725	3'592	1'523	2'806	4'329
		Wheat, soft, animal feed	27'178	659	423	639	1'062
	Bought	Beans, field	69'797	4'235	580	868	1'448
		Maize gluten					
		Oats	38'290	1'437	609	1'122	1'732
		Peas, field	85'869	6'187	826	1'358	2'184
		Rapeseed cake	26'336	1'623	520	706	1'226
		Rapeseed oil					
		Soy cake	229'904	14'153	3'235	3'579	6'815
		Laying hens total	694'312	36'273	9'728	13'894	23'622

Source: FiBL calculations based on Voutila based on national sources

7.1.5 France

For France, data were supplied by Antoine Roinsard of the Technical Institute for Organic Agriculture (ITAB).

The following information was provided:

- Data on the total organic area (Area [ha]) (Agence Bio)
- Data on the total organic production ([yield], [mt]) (expert survey for some crops, for others : 0.7 times that of conventional according to FAOSTAT)
- Total estimated production volume animal feed (EF [mt]) (calculations Antoine Roinsard, Institut Technique de l'Agriculture Biologique - ITAB)
- Data on Livestock numbers (Agence Bio 2012)
- Further Info on Pigs and poultry like average slaughter weight (pigs: expert survey; poultry: Dupetit, 2011, Conan, 2011)
- Feeding practices for pigs, laying hens, and broilers (Agence Bio/FAM Data treatment)

With about 334'000 metric tons of concentrate feed (DM), France is the biggest producer of organic feed crops within the observed countries. Supply in feed slightly exceeds the country's demand (self-sufficiency rate over 100 percent), but the self-sufficiency rate for crude protein is only 74 percent (Figure 41). This indicates that, for a balanced animal diet, France has to import crops and secondary feedstuff with high protein content from other countries.

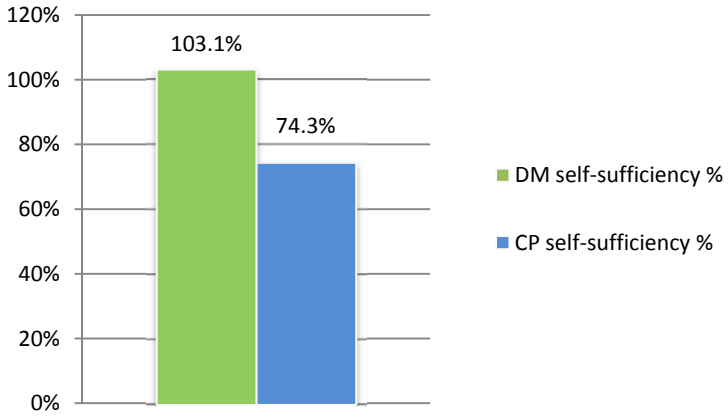


Figure 41: France: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: FiBL calculation based on Roinsard

In accordance with the supply situation for crude protein, the self-sufficiency rate for the amino acids lies between 63 percent and 72 percent (Figure 42).

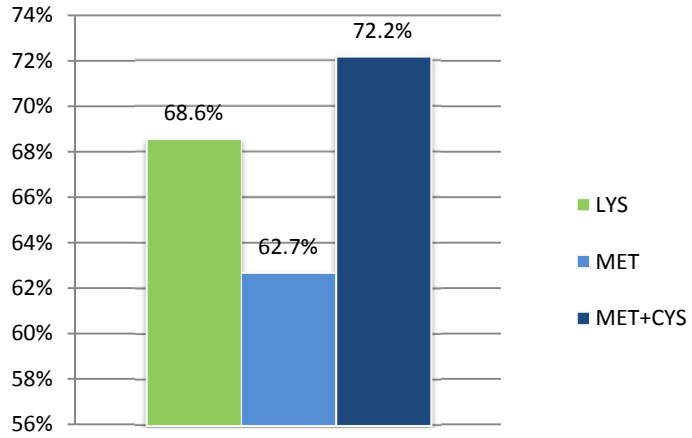


Figure 42: France: Self-sufficiency rate for amino acids 2011

Source: FiBL calculation based on Roinsard

France has the highest number of organic poultry and is the leader in this area within the observed countries. This is reflected by the high demand for feed for poultry (58 percent) (Figure 43). Bovine animals require only half of the demand of poultry (31 percent), and pigs have the smallest demand (11 percent).

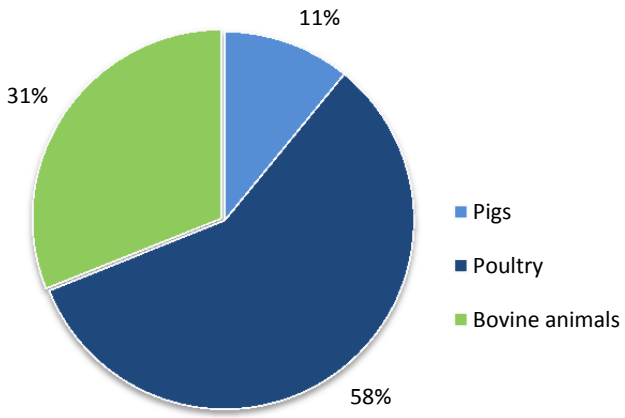


Figure 43: France: Demand (%) for concentrate feed (DM) of the different species 2011

Source: FiBL calculation based on Roinsard

Almost the same picture emerges when looking at Figure 44, which describes the demand (%) for crude protein of the respective species. Poultry still has the greatest requirement (59 percent). The demand for crude protein for bovine animals is about 30 percent and for pigs about 11 percent.

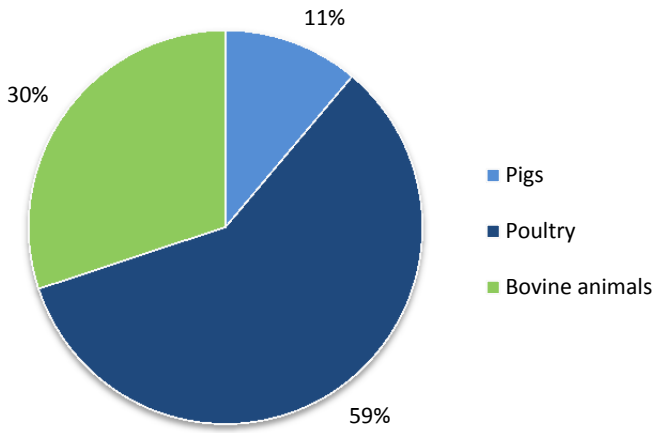


Figure 44: France: Demand (%) for crude protein of the different species 2011

Source: FiBL calculation based on Roinsard

As already mentioned before, France is the leader in organic poultry production and has the highest number of animals in this category. In terms of pig and bovine production, it ranges in the upper middle (Table 40).

Table 40: France: Number of organic animals 2011

Animal Species	Category	Indicator	Number
Bovine animals	Dairy cows	Animals [heads]	79'388
	Suckler cows	Animals [heads]	76'318
Pigs	Breeding sows	Animals, places [no]	6'962
	Fattening pigs	Animals, slaughtered [no]	81'825
Poultry	Broilers	Animals, slaughtered [no]	7'692'324
	Laying hens	Animals, places [no]	2'991'557

Source: Roinsard based on national data sources

The feed, protein, and amino acid demand per animal and type conforms to the demand in the other mentioned European countries (Table 41). Only broilers represent an exception. The need of concentrate feed (about 6.0 kg DM) and crude protein (over 1 kg) per slaughtered animal is comparatively higher. This is due to the fact that the average broiler age at slaughter in France is higher for organic production (around 90 days).

Table 41: France: Total need of concentrate feed, protein and amino acid per animal species and indicator 2011

Animal Species	Category	Indicator	Total feed DM [kg]	Total DE [MJ]	Total ME [MJ]	Total Crude Protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met + Cys [kg]
Bovine[11]	Dairy cows*	per head and year	1'042	16'088		187	8.47	2.87	6.60
	Suckler cows**	per LSU and year	294	4'540		37	1.25	0.61	1.47
Pigs	Breeding sows	per litter	671	8'330	8'680	110	5.13	1.88	3.74
	Fattening pigs	per number slaughtered	280	4'160	4'333	52	2.63	0.78	1.55
	Gilts	per head	254	3'537	3'684	39	2.33	0.75	1.49
	Weaners	per head	27.4	394	409	5.3	0.36	0.12	0.23
Poultry	Broilers	per number slaughtered	6.0	84.9		1.3	0.06	0.02	0.05
	Laying hens	per place and year	41.9	477		6.9	0.30	0.14	0.27
	Rearing pullets	per head	6.9	80		1.2	0.06	0.03	0.05

Source: FiBL calculations based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand) and inputs from Roinsard based on national data sources.
* Dairy cows: 16% protein and concentrate feed
** Suckler cows: 5% protein and concentrate feed

Due to its geographical situation, France is in the position to cultivate a wide range of crops (Table 42). Cereals, for which no further details are available, play the biggest role in organic crop cultivation (about 85'000 metric tons on a dry matter basis), followed by grain maize with 64'000 metric tons (DM), and triticale with about 54'000 metric tons (DM). Within the observed countries, France grows the biggest quantity of soybeans, about 12'000 metric tons (DM).

Table 42: France: Estimated concentrate feed production 2011

Crop	Production EF [mt]*	Production DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley	43'306	37'676	681'940	544'346	496'949	3'724'483	134'824	86'466	61'808	148'275
Beans, field	25'605	22'276	426'592	319'496	261'079	6'593'800	400'083	81'976	54'800	136'777
Lupine	194	169	3'533	2'516	1'482	60'541	2'797	800	385	1'185
Maize, grain	73'344	63'809	1'176'643	1'018'702	1'018'396	5'223'109	151'866	128'543	108'476	237'020
Peas, field	9'418	8'194	153'140	127'035	105'452	1'864'877	134'376	29'497	17'944	47'441
Soybeans	13'501	12'151	280'807			4'945'416	305'717	77'279	69'868	147'147
Sunflower seed	2'039	1'937				311'352	11'838	5'631	7'080	12'711
Triticale	62'035	53'970	968'770	839'348	774'476	5'582'973	198'638	143'129	97'714	240'843
Wheat, soft, animal feed	55'716	48'473	876'390	764'088	715'460	5'586'989	135'555	131'434	86'936	218'371
Cereals, no details*	98'193	85'428	1'546'245			8'444'976	304'978	196'057	140'144	336'202
Total	383'351	334'084	6114059	3'615'532	3'373'295	42'338'516	1'780'672	880'816	645'154	1'525'971

Source: FiBL calculation based on Roinsard and other data sources
*Production EF: Estimated production of feed
May include protein crops and oilseeds from mixed cropping

[11] Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

With a requirement of about 188'000 metric tons of concentrate feed (DM), poultry has the highest demand, followed by bovine animals, which need about 101'000 metric tons of concentrates (Table 43). Pigs require approximately 31'000 (DM) metric tons of concentrates. When looking at the crude protein and amino acid demand, a similar picture emerges. Again, poultry has by far the largest demand, followed by bovine animals and pigs (Table 44).

Table 43: France: Concentrate feed, energy and crude protein demand 2011

Animal Species	Category	Livestock Indicator	heads/no	feed DM per head/no [kg]	Total feed DM [mt]	Total ME [MJ]	Crude Protein [mt]
Pigs	Breeding sows	Litters [no]	13'924	671.00	9'343	115'986'920	1'532
	Fattening pigs	Animals, slaughtered [no]	81'825	280.00	22'911	340'392'000	4'255
	Gilts	Animals [heads]	2'437	254.35	620	8'617'974	97
	Weaners	Animals [heads]	86'735	27.38	2'374	34'058'036	456
Pigs total					35'248	499'054'930	6'340
Poultry	Broilers	Animals, slaughtered [no]	7'692'324	6.03	46'385	653'078'308	10'000
	Laying hens	Animals, places [no]	2'991'557	41.86	125'227	1'427'571'000	20'711
	Rearing pullets	Animals [heads]	2'393'246	6.86	16'427	192'201'554	2'798
Poultry total					188'039	2'272'850'862	33'508
Bovine animals	Dairy cows	Animals [heads]	79'388	1'042.00	82'722	1'277'194'144	14'870
	Suckler cows	LSU [no]	61'054	294.00	17'950	277'186'976	2'272
Bovine animals total					100'672	1'554'381'120	17'142
Total					323'959	4'326'286'913	56'990

Source: FiBL calculation based on Roinsard and other data sources
Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between.

Table 44: France: Total amino acid demand 2011

Animal Species	Category	Crude Protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Pigs	Breeding sows	1'532	71'430	26'177	52'076
	Fattening pigs	4'255	215'200	63'987	126'829
	Gilts	97	5'682	1'830	3'628
	Weaners	456	31'311	9'974	20'122
Pigs total		6'340	323'623	101'969	202'655
Poultry	Broilers	10'000	484'616	176'923	392'309
	Laying hens	20'711	900'459	424'801	792'763
	Rearing pullets	2'798	138'808	59'831	112'483
Poultry total		33'508	1'523'883	661'556	1'297'554
Bovine animals	Dairy cows	14'870	672'416	227'844	523'961
	Suckler cows	2'272	76'074	37'243	89'994
Bovine animals total		17'142	748'490	265'087	613'955
Total		56'990	2'595'997	1'028'611	2'114'164

Source: FiBL calculation based on Roinsard and other data sources

7.1.6 Germany

The data for Germany were provided by Diana Schaack of the Agricultural Information Company (AMI) (livestock numbers and feedstuff volumes), by Gerhard Bellof, Weihenstephan-Triesdorf University of Applied Sciences (feeding practices), and by Friedrich Weissmann, Thünen Institute (feeding practices).

The following information was provided:

- Data on the total organic area ((Area [ha]) (Source: AMI-Erhebung bei den Öko-Kontrollstellen 2009 – 2011; Statistisches Bundesamt 2009-2012)
- Total estimated production volume animal feed ([mt]) (AMI)
- Data on Livestock (AMI and own calculation Bellof)
- Feeding practices for pigs, laying hens, and broilers (Bellof)

Germany has a self-sufficiency rate for concentrate feed (DM) of almost 70 percent (Figure 45). Crude protein supply is slightly lower. Regarding the supply of organic feed, Germany is in the middle of the observed countries.

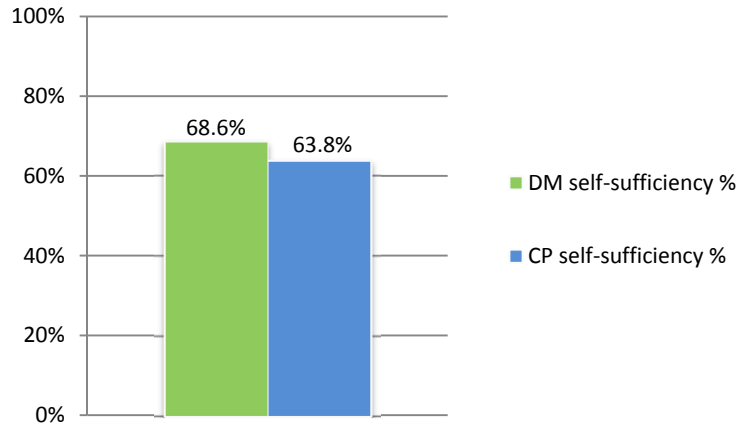


Figure 45: Germany: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: FiBL calculations based on Bellof, Schaack, and Weissmann

Lysine is the most available amino acid; more than 60 percent of the demand can be covered by national feed production (Figure 46).

As seen in Figure 45, the self-sufficiency in crude protein is lower than the self-sufficiency in concentrate feed. This indicates that, in particular, crops with high protein content have to be imported, especially crops and secondary feed products with a good source of methionine and cysteine, the sulphur containing amino acids (see Figure 46).

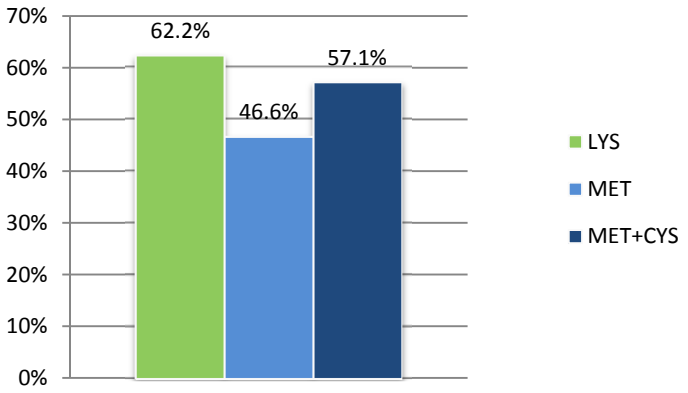


Figure 46: Germany: Self-sufficiency rate for amino acids 2011

Source: FiBL calculations based on Bellof, Schaack, and Weissmann

Figure 47 shows the proportional impacts of different species on the total feed demand. Bovine animals account for the largest share of feed (43 percent), followed by poultry (34 percent) and pigs (23 percent).

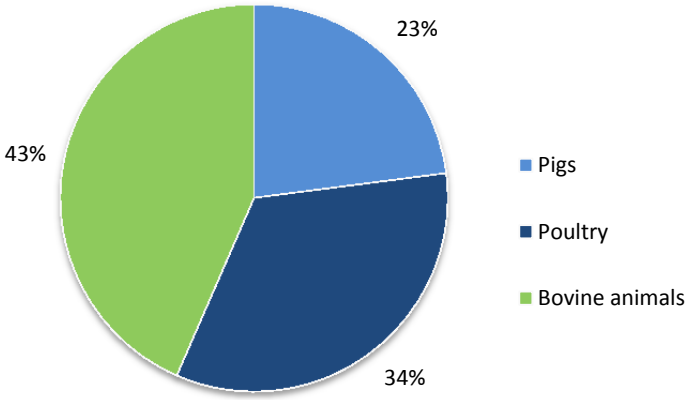


Figure 47: Germany: Demand (%) for concentrate feed (DM) of the different species 2011

Source: FiBL calculations based on Bellof, Schaack, and Weissmann

When looking at Figure 48, which shows the demand of the respective species for crude protein, a similar picture, with a slight shift in of relations, emerges. Bovine animals still have the greatest need (36 percent), followed by poultry (37 percent) and pigs (27 percent).

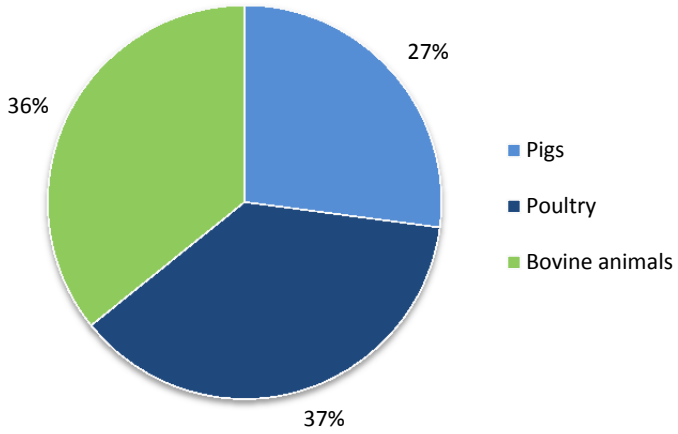


Figure 48: Germany: Demand (%) for crude protein of the different species 2011

Source: FiBL calculations based on Bellof, Schaack, and Weissmann

Of the observed countries, Germany has the highest number of bovine animals and pigs (Table 45). In organic poultry production, France and the United Kingdom are ahead.

Table 45: Germany: Number of organic animals 2011

Animal Species	Category	Indicator	No
Bovine animals	Dairy cows	Animals [heads]	139'000
	Suckler cows	Animals [heads]	127'000
Pigs	Breeding sows	Animals, places [no]	15'800
	Fattening pigs	Animals, slaughtered [no]	256'000
Poultry	Broilers	Animals, [heads]	580'000
	Ducks	Animals, slaughtered [no]	25'000
	Geese	Animals, slaughtered [no]	38'000
	Laying hens	Animals, places [no]	2'900'000
	Rearing pullets	Animals, places [no]	950'000
	Turkeys	Animals, slaughtered [no]	222'000

Source: Schaack, based on national data sources

The demand for feed, protein and amino acids per individual (pigs and poultry) do not differ from the respective requirements of animals in other countries. The nutrient needs of dairy cows are found to be in the European midrange, indicating the presence of high and low input systems (Table 46).

Wheat is the most produced organic energy crop (about 91'000 metric tons DM), followed by triticale and rye (Table 47). The most produced protein crops are beans (22'000 metric tons DM), followed by lupins and peas. Germany also cultivates soybeans but less than France and Austria.

Table 46: Germany: Total need of concentrate feed, protein and amino acid per animal species and indicator 2011

Animal Species	Category	Indicator	Total Feed DM [kg]	Total ME[MJ]	Total DE pigs [MJ]	Total crude Protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met + Cys [kg]
Bovine[12]	Dairy cows*	per head and year	1177	18162		148	4.98	2.44	5.90
	Suckler cows**	per LSU and year	294	4'540		37	1.25	0.61	1.47
Pigs	Breeding sows***	per litter	671	8'330	8'680	110	5.13	1.88	3.74
	Fattening pigs	per number slaughtered	280	4'160	4'333	52	2.63	0.78	1.55
	Gilts	per head	254	3'536	3'684	39	2.33	0.75	1.49
	Weaners	per head	27	392	409	5.3	0.36	0.12	0.23
Poultry	Broilers	per number slaughtered	4.9	69		1.1	0.05	0.02	0.04
	Laying hens	per place and year	41.9	477		6.9	0.30	0.14	0.27
	Rearing pullets	per head	6.9	80		1.2	0.06	0.03	0.05

Source: Source: FiBL calculations based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand)
* Dairy cows: 20% protein and concentrate feed (cereals, leguminous crops) only this part is shown in the table
** Suckler Cows: 5% protein and concentrate feed; only this part is shown in the table. (per livestock unit, 1 suckler cow= 0.8 LSU)
** *Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between

Table 47: Germany: Estimated concentrate feed production 2011

Crop	Production EF [mt]*	Production DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley	37'000	32'190	582'639	465'081	424'586	3'182'143	115'192	73'876	52'808	126'684
Beans, field	25'800	22'446	429'841	321'930	263'067	6'644'016	403'130	82'601	55'217	137'818
Lupine	22'500	19'575	409'705	291'840	171'869	7'021'553	324'358	92'786	44'631	137'417
Oats	15'200	13'224	248'743	170'240	159'085	1'342'104	50'357	39'341	21'357	60'698
Peas, field	15'000	13'050	243'905	202'327	167'954	2'970'180	214'020	46'980	28'580	75'560
Rye	43'750	38'063	679'796	587'563	466'266	3'655'903	130'707	94'471	55'971	150'442
Soy-beans	1'920	1'728	39'934			703'296	43'476	10'990	9'936	20'926
Triticale	85'000	73'950	1'327'403	1'150'070	1'061'183	7'649'758	272'173	196'115	133'886	330'002
Wheat	104'500	90'915	1643'743	1'433'111	1'341'905	10'478'863	254'244	246'516	163'056	409'572
Total	350'670	305'141	5605709	4'622'163	4'055'913	43'647'815	1'807'657	883'676.88	565'442	1'449'118

Source: FiBL calculations based on different sources
*Production EF: Estimated production of feed

Around 445'000 metric tons of concentrate feedstuff (DM) are necessary to feed all livestock in Germany (Table 48 and Table 49). About 193'000 metric tons are used for bovine animals, followed by poultry with a requirement of 149'000 metric tons. Pigs come in last with 102'000 met-

[12]Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

ric tons. When looking at the crude protein and amino acid demand, relations shift: poultry shows a greater demand than bovine animals (Table 49).

Table 48: Germany: Concentrate feed, energy and crude protein demand 2011

Animal Species	Category	Livestock Indicator	heads/no	Feed DM per head/no [kg]	Total feed DM [mt]	Total ME [MJ]	Crude Protein [mt]
Pigs	Breeding sows*	Litters [no]	31'600	671.00	21'204	263'228'000	3'476
	Fattening pigs	Animals, slaughtered [no]	256'200	280.00	71'736	1'065'792'000	13'322
	Gilts**	Animals [heads]	7'110	254.35	1'808	25'146'221	283
	Weaners***	Animals [heads]	271'572	27.38	7'434	106'638'177	1'428
Pigs total					102'182	1'460'804'399	18'509
Poultry	Broilers	Animals, slaughtered [no]	2'407'000	4.87	11'722	166'083'000	2'575
	Laying hens	Animals, places [no]	2'900'000	41.86	121'394	1'383'880'000	20'077
	Rearing pullets	Animals [heads]	2'375'000	6.86	16'302	190'736'250	2'776
Poultry total					149'418	1'740'699'250	25'429
Bovine animals**	Dairy cows	Animals [heads]	139'000	1'177.00	163'603	2'524'518'000	20'690
	Suckler cows	LSU [no]	101'600	294.00	29'870	461'264'000	3'781
Bovine animals total					193'473	2'985'782'000	24'471
Total					445'074	6'187'285'649	68'408

Source: FiBL calculations based on Bellof, Schaack, and Weissmann

* Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between; 2 litters per year
** Gilts: calculated from average replacement rate of breeding sows = 30%
*** Weaners: calculated from number of slaughtered fattening pig plus additional 6% for gilts, losses, etc.
**** Bovine animals: only protein and energy feed shown in the table, Dairy cows: 20% of total dry weight.

Table 49: Germany: Total amino acid demand 2011

Animal species	Category	Crude protein [mt]	Total LYS [kg]	Total MET [kg]	Total MET + CYS [kg]
Pigs	Breeding sows	3'476	162'108	59'408	118'184
	Fattening pigs	13'322	673'806	200'348	397'110
	Gilts	283	16'581	5'340	10'587
	Weaners	1'428	98'037	31'231	63'005
Pigs total		18'509	950'532	296'327	588'885
Poultry	Broilers	2'575	125'164	45'733	101'094
	Laying hens	20'077	872'900	411'800	768'500
	Rearing pullets	2'776	137'750	59'375	111'625
Poultry total		25'429	1'135'814	516'908	981'219
Bovine animals	Dairy cows	20'690	692'637	339'160	819'683
	Suckler cows	3'781	126'594	61'976	149'758
Bovine animals total		24'471	819'231	401'136	969'441
Total		68'408	2'905'577	1'214'371	2'539'546

Source: FiBL calculations based on Bellof, Schaack, and Weissmann

For Table 50 and Table 51experts were asked to list the most prevalent home-grown and purchased feed components in percent. According to the rough estimates by the experts, for fattening pigs, most concentrate feed components are home-grown. These include cereals (67 percent) and grain legumes (15 percent). Bought components are, to equal parts, grain legumes, potato protein, and soy cake (5 percent each). Broiler feed contains home-grown cereals (65 percent) and grain legumes (15 percent). Also, layer feed consists mainly of home-grown cereals (55 percent) and grain legumes (15 percent). Minerals, soy cake, soybeans and also grain legumes are bought components (Please also read the general note (7.1.1) for these two feeding practice tables).

Table 50: Germany: Feeding practices and derived calculated feed, energy and protein consumption 2011 for fattening pigs, broilers and laying hens (proportions of diets (%) are estimates of main feeding components)

Animal Species	Own or Bought	Crop	Share in feed %	DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	CP [kg]
Fattening pigs	Own	Cereals FP	67.0%	48'063	866'457'896	740'648'834		5'137'347
		Grain legumes FP	15.0%	10'760	206'492'076	158'689'214		3'031'743
	Bought	Grain legumes FP	5.0%	3'587	68'830'692	52'896'405		1'010'581
		Potato protein	5.0%	3'587	82'065'984	63'632'701		2'989'598
		Soy cake	5.0%	3'587	74'354'364	56'711'612		1'748'565
Fattening pigs total			97.0%	69'584	1'298'201'012	1'072'578'767		13'917'833
Broilers	Own	Cereals FP	65.0%	7'619	137'357'985			814'414
		Grain legumes FP	15.0%	1'758	33'742'036			495'405
Broilers total			80.0%	9'378	171'100'021			1'309'819
Laying hens	Own	Cereals FP	55.0%	66'767	1'203'636'684			7'136'526
		Grain legumes FP	15.0%	18'209	349'432'629			5'130'414
	Bought	Grain legumes FP	5.0%	6'070	116'477'543			1'710'138
		Minerals	10.0%	12'139				
		Soy cake	7.5%	9'105	188'737'322		100'423'187	4'438'468
		Soybeans	7.5%	9'105	210'406'151			3'705'552
Laying hens total			100.0%	121'394	2'068'690'328			22'121'098

Source: FiBL calculations based on Bellof, Schaack, and Weissmann

Table 51: Germany: Feeding practices and derived calculated amino acid consumption 2011 for fattening pigs, broilers and laying hens

Animal Species	Own or Bought	Crop	CP [kg]	LYS [kg]	MET [kg]	CYS [kg]	MET + CYS [kg]
Fattening pigs	Own	Cereals FP	5'137'347	158'328	84'240	124'767	209'007
		Grain legumes FP	3'031'743	186'725	25'405	40'481	65'886
	Bought	Grain legumes FP	1'010'581	62'242	8'468	13'494	21'962
		Potato protein	2'989'598	220'516	67'001	44'907	111'908
		Soy cake	1'748'565	107'640	24'605	27'224	51'829
Fattening pigs total			13'917'833	735'452	209'721	250'872	460'593
Broilers	Own	Cereals FP	814'414	25'100	13'354	19'779	33'134
		Grain legumes FP	495'405	30'512	4'151	6'615	10'766
Broilers total			1'309'819	55'612	17'506	26'394	43'900
Laying hens	Own	Cereals FP	7'136'526	219'941	117'022	173'320	290'342
		Grain legumes FP	5'130'414	315'983	42'992	68'503	111'494
	Bought	Grain legumes FP	1'710'138	105'328	14'331	22'834	37'165
		Minerals					
		Soy cake	4'438'468	273'228	62'457	69'104	131'561
		Soybeans	3'705'552	229'070	52'351	57'905	110'256
Laying hens total			22'121'098	1'143'549	289'153	391'665	680'818

Source: FiBL calculations based on Bellof, Schaack, and Weissmann

7.1.7 Lithuania

Data for Lithuania were provided by Virgilijus Skulskis of the Lithuanian Institute of Agrarian Economics, based on national sources and estimates.

The following information was provided:

- Data on the total organic area (fully converted and in-conversion, Area [ha]), (Eurostat and Ekoagros data)
- Total crop production volume from fully converted areas ([mt]) (Eurostat)
- Total estimated production volume animal feed ([mt]) (Estimation V. Skulskis LIAE)
- Data on Livestock (Eurostat and Ekoagros data)
- Feeding practices for pigs, laying hens and broilers (based on information of researchers, the certification body and consultants)

Lithuania is the country with the lowest number of organic animals and with the best supply of organic feed within the ICOPP project. Its production exceeds the demand by a multiple of 4.3 (Figure 49). The farmers are able to produce about 50'000 metric tons on a dry matter basis. This results in a self-sufficiency rate for concentrate feed (DM) of 430 percent. When looking at the supply situation for crude protein (CP), the self-sufficiency rate is even higher at about 524 percent, which is unique within the observed countries and reflects the potential of Lithuania for being a protein crop exporting country.

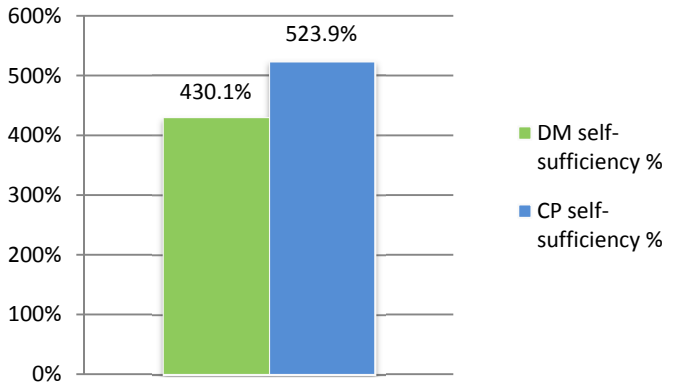


Figure 49: Lithuania: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: FiBL calculations based on Skulskis

In accordance with the supply situation for crude protein, the self-sufficiency rate for lysine greatly exceeds the demand. For the sulphur containing amino acids, the availability is slightly lower, but it is still around 400 percent (Figure 50).

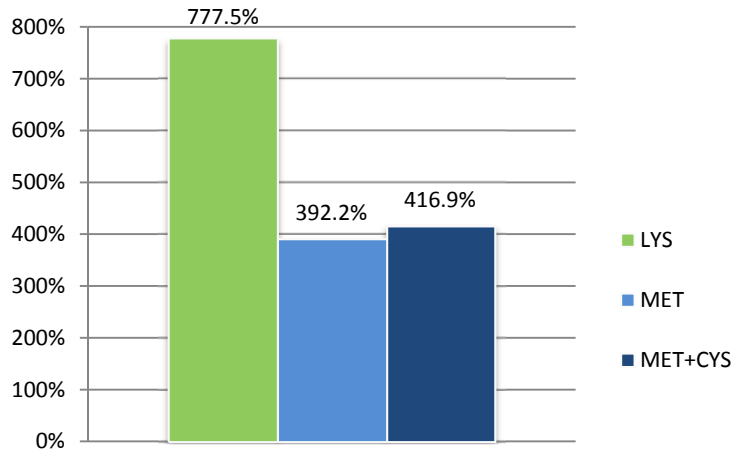


Figure 50: Lithuania: Self-sufficiency rate for amino acids 2011
Source: FiBL calculations based on Skulskis

The actual ratio of livestock numbers between the three animal species (Table 52) is reflected by the demand of feed per species. Bovine animals require by far the most feed (98 percent). There are only very few poultry and pigs, and their demand is only 1 percent each (Figure 51).

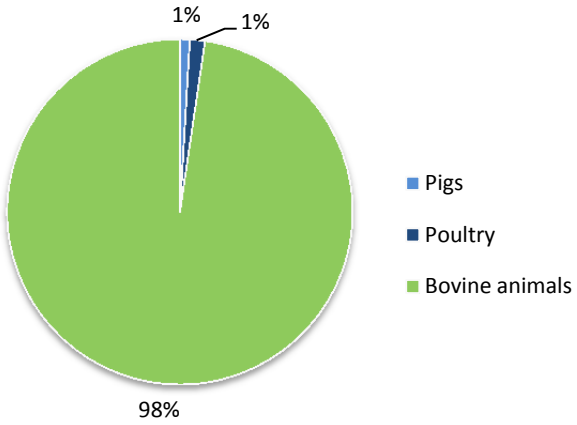


Figure 51: Lithuania: Demand (%) for concentrate feed (DM) of the different species 2011
Source: FiBL calculations based on Skulskis

A similar picture with a very slight shift of relations emerges from Figure 52, which describes the demand (%) for crude protein of the respective species relating to the total crude protein quantity. Still, bovine animals have the greatest need (97 percent). The demand for crude protein for poultry is about 2 percent, and for pigs, it is about 1 percent.

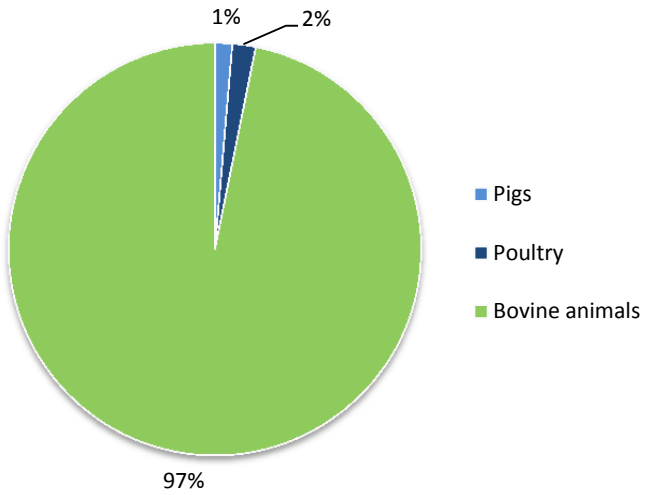


Figure 52: Lithuania: Demand (%) for crude protein of the different species 2011

Source: FiBL calculations based on Skulskis

The main reason for the high self-sufficiency rates is the low number of animals in all categories (Table 52) in relation to Lithuania's amount of feed production. With approximately 344 slaughtered pigs per year and about 3'884 places for laying hens, Lithuania has the lowest number of organic animals within the observed countries. Only for bovine animals, Finland has fewer animals than Lithuania.

Table 52: Lithuania: Number of organic animals 2011

Animal Species	Category	Indicator	Numbers
Bovine animals	Bovine animals, other	Animals [heads]	14'216
	Dairy cows	Animals [heads]	8'887
	Suckler cows	Animals [heads]	3'359
Other livestock	Rabbits	Animals [heads]	141
Pigs	Fattening pigs	Animals, slaughtered [no]	344
	Pigs, no details	Animals [heads]	474
Poultry	Laying hens	Animals, places [no]	3'884
	Poultry	Animals [heads]	4'406
Equidae	Horses	Animals [heads]	447
Goats	Goats	Animals [heads]	640
Sheep	Sheep	Animals [heads]	14'276

Source: Skulskis based on national data sources

The feed, protein, and amino acid demand of poultry and pigs conforms to the demand in the other mentioned European countries (Table 53). The need of concentrate feed for dairy cows (1'177 kg DM) and crude protein (148.85 kg) per cow and year is comparable with the data for Germany.

Table 53: Lithuania: Total need of concentrate feed, protein and amino acid per animal species and indicator 2011

Animal Species	Category	Indicator	Total Feed DM [kg]	Total ME [MJ]	Total Crude Protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met+Cys [kg]
Bovine[13]	Dairy cows*	per head and year	1'177	18'162	148	4.98	2.44	5.90
	Suckler cows**	per LSU and year	294	4540	37	1.25	0.61	1.47
Pigs	Fattening pigs	per number slaughtered	280	4'160	52	2.63	0.78	1.55
	Weaners	per head	27.4	393	5.2	0.36	0.12	0.23
Poultry	Laying hens	per place and year	41.9	477	6.9	0.30	0.14	0.27

Source: Source: FiBL calculations based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand) and inputs from Skulskis
* dairy cows: 20 percent protein and concentrate feed
**Suckler cows: 5 percent protein and concentrate feed

Field peas are the most produced crop (about 11'300 metric tons DM), followed by cereal grains (10'600 metric tons DM) (Table 54). Lithuania also cultivates soybeans, but less than France, Austria, and Germany, with only about 240 metric tons (DM). Due to national rules for organic farming, Lithuania has a high production of leguminous crops[14].

[13] Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

[14] The National rules for organic farming adopted on 28 December 2000 by the order No 3D-375 of the Minister of Agriculture of the Republic of Lithuania (last version on 10 April 2014, No 3D-209) state (see annex for details):

8. On organic production areas controlled by a certification body (with the exception of the fields, where perennial and biennial plants are grown), suitable crop rotation must be implemented through the cultivation of legumes (field beans, peas, lentils, beans, soya, vetch, clover, sweet clover, serradilla, lupine, sainfoin, lucerne, galega (goat's-rue) or catch crops (white mustard, oil radish, buckwheat, bluebell, clover, alfalfa, lupine, spring rape) or green manure crops. Legumes/catch crops/green manure crops must be grown on each field at least once in the previous two calendar years or grown in the calendar year, or expected to be grow in the coming calendar year. The sowing year is growing year. Aftercrops should be sown no later than 1 September of the current year. Mixed cereals – protein crops (peas, field beans and sweet lupines) – oilseeds (where protein plants are predominant), vetch and their mixtures (where vetch is predominant) are also considered as leguminous crops.

9. The crops mentioned in paragraph 8 may not be cultivated on organic fields if these were fertilized with organic fertilizer (solid manure, semi-liquid manure, liquid manure or slurry) at least once during the previous two calendar years or during the current calendar year or will be fertilized in the following calendar year. The minimum amount of the above-mentioned organic fertilizer must not be less than 70 kg/hectares per year of the amount of nitrogen.

Table 54: Lithuania: Estimated concentrate feed production 2011

Crop	Production EF [mt]	Production DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley* **	4'000	3'480	62'988	50'279	45'901	344'015	12'453	7'987	5'709	13'696
Beans, field	3'392	2'951	56'517	42'329	34'589	873'585	53'005	10'861	7'260	18'121
Lupine	2'467	2'146	44'915	31'993	18'841	769'749	35'558	10'172	4'893	15'065
Maize, grain	4'067	3'538	65'246	56'488	56'471	289'627	8'421	7'128	6'015	13'143
Mixed cereal grains	12'156	10'576	192'589			1'087'740	36'003	27'661	17'233	44'894
Peas, field*	13'000	11'310	211'384	175'350	145'560	2'574'156	185'484	40'716	24'769	65'485
Soybeans	265	238	5'510			97'033	5'998	1'516	1'371	2'887
Triticale	10'095	8'783	157'655	136'593	126'036	908'557	32'326	23'293	15'902	39'194
Wheat, soft, animal feed**	7'500	6'525	117'972	102'855	96'309	752'072	18'247	17'693	11'703	29'395
Total	56'943	49'548	914'775	595'888	523'708	7'696'534	387'497	147'025	94'854	241'879

Source: FiBL calculations based on Skulskis

Production EF: Estimated production of feed
* Peas, about 90 percent for feed production (14'574.2 metric tons total production)
** Wheat: about 35 percent for feed production (20'894 metric tons total production)
***Barley: about 40 percent for feed production (10'296.6 metric tons total production)
All others estimated as 100 percent for feed production

Only 11'500 metric tons of concentrate feedstuff (DM) is necessary to feed all organic livestock in Lithuania (Table 55 and Table 56). The majority, about 12'250 metric tons, is used for bovine animals; poultry requirements follow with about 160 metric tons. For pigs, only about 110 metric tons are necessary. When looking at the crude protein and amino acid demand, the ratios are slightly different, but bovine animals still have the biggest demand, followed by poultry and pigs (Table 56).

Table 55: Lithuania: Concentrate feed, energy and crude protein demand 2011

Animal Species	Category	Livestock Indicator	heads/no	Feed DM per head/no [kg]	Total Feed DM [mt]	Total ME [MJ]	Crude Protein [mt]
Pigs	Fattening pigs	Animals, slaughtered [no]	344	280.00	96	1'431'040	18
	Weaners	Animals [heads]	365	27.38	10	143'183	2
Pigs Total			709	307.38	106	1'574'223	20
Poultry	Laying hens	Animals, places [no]	3'884	41.86	163	1'853'445	27
Poultry Total			3'884	41.86	163	1'853'445	27
Bovine animals	Dairy cows	Animals [heads]	8'887	1'177.00	10'460	161'405'694	1'323
	Suckler cows	LSU [no]	2'687	294.00	790	12'199'888	100
Bovine animals Total			11'574	1'471.00	11'250	173'605'582	1'423
Total				1'820.24	11'519	177'033'250	1'470

Source: FiBL calculations based on Skulskis

* Bovine animals: only protein and energy feed, Dairy cows: 20 percent of total DM, Suckler cows: 5 percent of total DM.

Table 56: Lithuania: Total amino acid demand 2011

Animal Species	Category	Crude Protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Pigs	Fattening pigs	18	905	269	533
	Weaners	2	132	42	85
Pigs Total		20	1'036	311	618
Poultry	Laying hens	27	1'169	552	1'029
Poultry Total		27	1'169	552	1'029
Bovine animals	Dairy cows	1'323	44'284	21'684	52'407
	Suckler cows	100	3'348	1'639	3'961
Bovine animals total		1'423	47'632	23'323	56'368
Total		1'470	49'838	24'186	58'015

Source: FiBL calculations based on Skulskis

7.1.8 Netherlands

Data were provided by Monique Bestman and Jan-Paul Wagenaar of Louis Bolk Institute.

The following information was provided:

- Data on the total organic area (Area [ha]);(CBS Statline)
- Data on the organic production ([yield]) (CBS Statline)
- Total estimated area share used as animal feed [%] and estimated production volume animal feed ([mt]) (% used as animal feed expert judgement by Udo Prins, researcher sustainable crop farming at LBI)
- Data on Livestock numbers (CBS Statline)
- Further info on pigs and poultry, such as average slaughter weight (pigs: Herman Vermeer (WUR) and Jan Leeijen (Groeneweg slaughterhouse); broilers: Herman Kemper (biggest organic broiler slaughter in NL))
- Feeding practices for pigs, laying hens and broilers (CBS Statline plus expert judgment by Udo Prins, researcher sustainable crop farming at LBI)

Within the observed countries of the ICOPP project, the Netherlands has the biggest gap between its feed production and the demand. Like Switzerland, which also has a low animal feed self-sufficiency rate, arable land in the Netherlands is very valuable and mainly used for crops with higher profit margins per hectare (vegetables, cereals for human consumption).

In 2011, the Netherlands produced only slightly more than 9’000 metric tons of concentrate feed (DM) but required more than 145’000 metric tons. The picture is similar for crude protein, where only about 1’000 metric tons are produced, but almost 24’000 metric tons are required (see Table 59 and Table 60). This corresponds to a self-sufficiency rate of 6.2 percent for concentrate feed (DM) and 4.2 % for crude protein (Figure 53)

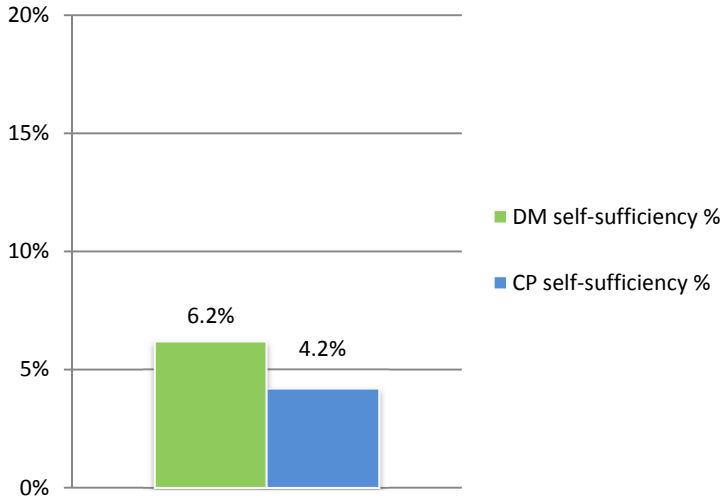


Figure 53: Netherlands: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: FiBL calculation based on Bestman and Wagenaar

In accordance with the marginal supply situation for crude protein, the self-sufficiency rate for amino acids is around four percent, whereas the availability of sulphur-containing amino acids is slightly higher than for Lysine (Figure 54).

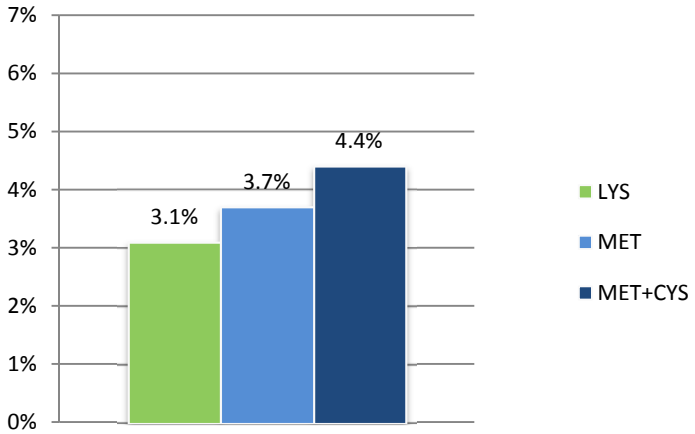


Figure 54: Netherlands: Self-sufficiency rate for amino acids 2011

Source: FiBL calculation based on Bestman and Wagenaar

The actual livestock number ratio between the three animal species (see Table 57) is reflected by the demand for feed per species. In contrast to most of the other observed countries, where bovine animals require by far the most feed, in the Netherlands, the demands for feed for bovine animals and poultry are close together: most of the feed, 42 percent is required for poultry, and 38 percent is required for bovine animals.

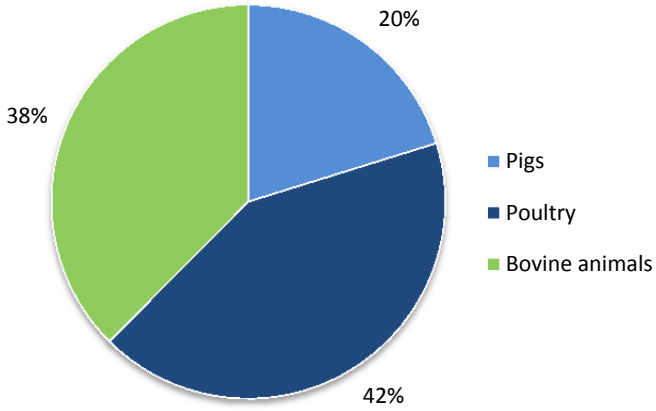


Figure 55: Netherlands: Demand (%) for concentrate feed (DM) of the different species 2011

Source: FiBL calculation based on Bestman and Wagenaar

A similar picture with a slight shift of relations emerges from Figure 56, which describes the amount of the demand for crude protein of the respective species. Bovine animals need about 34 percent; this is reduced compared to their demand for concentrate feed. The demand for crude protein for poultry and pigs, in contrast, is relatively higher (44 percent, respectively 22 percent) than for concentrate feed.

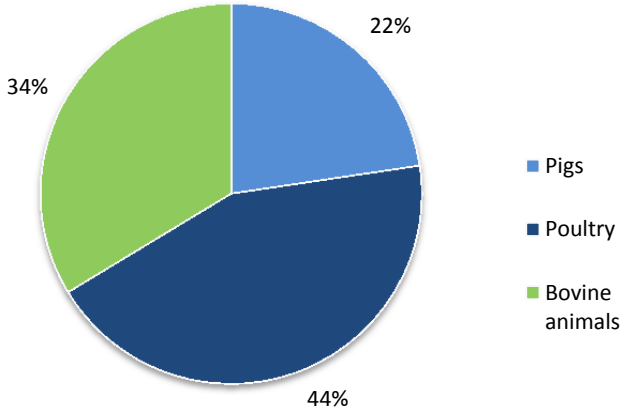


Figure 56: Netherlands: Demand (%) for crude protein of the different species 2011

Source: FiBL calculation based on Bestman and Wagenaar

The Netherlands, with about 38'000 organic dairy cows, is in the lower half of the ICOPP-countries (Table 57). In poultry production, the situation is quite reversed. Here, the Netherlands' production ranges in the upper middle, after France, the U.K., and Germany. In the domain of pig production, it is equally placed. These circumstances are visible above in the concentrate feed and crude protein breakdown (Figure 55 and Figure 56).

Table 57: Netherlands: Number of organic animals 2011

Animal Species	Category	Indicator	
Bovine animals	Bovine animals aged between 1 and 2 years	Animals [heads]	9'211
	Bovine animals less than 1 year old	Animals [heads]	11'668
	Bovine animals of 2 years and over, no details	Animals [heads]	28'525
	Dairy cows	Animals [heads]	38'204
	Suckler cows	Animals [heads]	11'201
Pigs	Breeding sows	Animals, places [no]	4'274
	Fattening pigs	Animals, slaughtered [no]	75'000
	Pigs, other	Animals, places [no]	23'609
Poultry	Broilers	Animals [heads]	63'520
	Laying hens	Animals, places [no]	1'236'175
	Rearing pullets	Animals, places [no]	530'705

Source: Bestman and Wagenaar based on national data sources

The feed, protein, and amino acid demand per animal and type conforms to the demand in the other mentioned European countries (Table 58).

Table 58: Netherlands: Total need of concentrate feed, protein and amino acid per animal species and indicator 2011

Animal Species	Category	Indicator	Total Feed DM [kg]	Total ME [MJ]	Total DE [MJ]	Total Crude Protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met+Cys [kg]
Bovine	Dairy cows*	per head and year	1370	20130		200	7.67	3.36	8.20
	Suckler cows		294	4540		37	1.25	0.61	1.47
Pigs	Breeding sows**	per litter	671	8330	8680	110	5.13	1.88	3.74
	Fattening pigs	per number slaughtered	280	4160	4333	52	2.63	0.78	1.55
	Gilts	per head	254	3536	3684	40	2.33	0.75	1.49
	Weaners	per head	27	392	409	5	0.36	0.12	0.23
Poultry	Broilers	per number slaughtered	5	69		1.1	0.05	0.02	0.04
	Laying hens	per place and year	42	477		6.9	0.30	0.14	0.27
	Rearing pullets	per head	7	80		1.2	0.06	0.03	0.05

Source: FiBL calculation based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand) and inputs from Bestman and Wagenaar based on national data sources

* Dairy cows: only the amount of concentrate feed (protein and energy feed) is shown in the table (mainly consisting of grains and leguminous); ME is the hypothetical amount of metabolizable energy for pigs of this concentrate feed.
**Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between

The estimated production of organic energy and protein crops for the use as concentrate feedstuff is relatively low (Table 59). Even for wheat, which normally is the most cultivated crop, production reaches only 3'500 metric tons (DM).

Table 59: Netherlands: Estimated concentrate feed production 2011

Crops	Production EF [mt]*	Production DM [mt]	Gross Energy [GJ]	ME pigs [GJ]	ME poultry [GJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley	3'395	2'954	53461	42'674	38'959	291'983	10'570	6'778	4'845	11'624
Beans, field	154	134	2566	1'922	1'570	39'658	2'406	493	330	823
Lupine	17	14	300	214	126	5'149	238	68	33	101
Oats	447	389	7315	5'006	4'678	39'468	1'481	1'156	628	1'785
Peas, field	40	35	650	540	448	7'920	571	125	76	201
Rye	674	586	10473	9'052	7'183	56'322	2'014	1'455	862	2'318
Triticale	1'724	1'500	26923	23'326	21'523	155'155	5'520	3'977	2'716	6'693
Wheat, soft, animal feed	4'058	3'530	63831	55'651	52'110	406'921	9'873	9'572	6'332	15'905
Total	10'509	9'142	165519	138'385	126'597	1'002'577	32'672	23'627	15'822	39'450

Source: FiBL calculation based on Bestman and Wagenaar
*Production EF: Estimated production of feed

Table 60 shows the total feed demand for organic animals for the Netherlands in 2011. About 146'000 metric tons of concentrate feedstuff (DM) and almost 24'000 metric tons of crude protein are necessary to feed all organic livestock in the Netherlands. About 55'000 metric tons of concentrate feed and 8'000 metric tons of crude protein are used for bovine animals. Poultry requires slightly more (62'000 metric tons and 10'000 metric tons respectively). For pigs, only about 30'000 metric tons of concentrate feed and 5'000 metric tons of crude protein are necessary. When the amino acid demand is considered the relations shift: poultry has the biggest demand for lysine and methionine, followed by bovine animals and pigs (Table 61).

Table 60: Netherlands: Concentrate feed, energy and crude protein demand 2011

Animal Species	Category	Livestock Indicator	heads/no	Feed DM per head/no [kg]	Total Feed DM [mt]	Total ME [MJ]	Crude Protein [mt]
Pigs	Breeding sows*	Litters [no]	8'975	671.00	6'022	74'765'082	987
	Fattening pigs	Animals, slaughtered [no]	75'000	280.00	21'000	312'000'000	3'900
	Gilts**	Animals [heads]	1'539	254.35	391	5'441'770	61
	Weaners***	Animals [heads]	79'500	27.38	2'176	31'217'265	418
Pigs total			165'014	1'232.72	29'590	423'424'117	5'367
Poultry	Broilers	Animals, slaughtered [no]	289'016	4.87	1'408	19'942'104	309
	Laying hens	Animals, places [no]	1'236'175	41.86	51'746	589'902'710	8'558
	Rearing pullets	Animals [heads]	1'273'692	6.86	8'743	102'290'205	1'489
Poultry total			2'798'883	53.59	61'896	712'135'019	10'356
Bovine animals	Dairy cows	Animals [heads]	38'204	1'370.00	52'339	769'046'520	7'648
	Suckler cows	LSU [no]	8'961	294.00	2'634	40'682'032	333
Bovine animals total			47'165	1'664.00	54'974	809'728'552	7'982
Total					146'461	1'945'287'687	23'705

Source: FiBL calculation based on Bestman and Wagenaar

* Breeding sows: Average No of litter per sow/year = 2.1
** Gilts: calculated from average replacement rate of breeding sows = 36%
*** Weaners: calculated from number of slaughtered fattening pig plus additional 6% for gilts, losses, etc.

Table 61: Netherlands: Total amino acid demand 2011

Animal Species	Category	Crude protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Pigs	Breeding sows	987	46'044	16'874	33'568
	Fattening pigs	3'900	197'250	58'650	116'250
	Gilts	61	3'588	1'156	2'291
	Weaners	418	28'700	9'143	18'444
Pigs total		5'367	275'581	85'822	170'553
Poultry	Broilers	309	15'029	5'491	12'139
	Laying hens	8'558	372'089	175'537	327'586
	Rearing pullets	1'489	73'874	31'842	59'864
Poultry total		10'356	460'992	212'870	399'589
Bovine animals	Dairy cows	7'648	293'063	128'480	313'273
	Suckler cows	333	11'165	5'466	13'208
Bovine animals total[15]		7'982	304'228	133'946	326'481
Total		23'705	1'040'801	432'638	896'623

Source: FiBL calculation based on Bestman and Wagenaar

According to the rough estimates by experts, feeding components for fattening pigs are mainly purchased; the only home-grown components are cereals, grain legumes and grain maize in small quantities between 0.5 and 2 percent (Table 61, Table 62 and Table 63). Purchased barley and wheat represent about 25 percent of the feed ration of each. The main purchased protein crops are peas and soybeans, with 10 percent, alternatively 8 percent, in the diet. For poultry, feeding components are also mainly purchased. Maize and wheat are the dominant energy sources; soybeans and sunflower cake serve as the main protein sources.

[15] Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

Table 62: Netherlands: Feeding practices and derived calculated feed, energy and protein consumption 2011 for fattening pigs, broilers and laying hens (proportions of diets (%) are estimates of main feeding components)

Animal Species	Own or Bought	Crop	Share in Feed %	DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	CP [kg]
Fattening pigs	Own	Cereals FP	2.0%	420	7'571'550	6'472'166		44'893
		Grain legumes FP	0.5%	105	2'014'950	1'548'490		29'584
		Maize, grain	0.5%	105	1'936'200	1'676'304		8'595
	Bought	Barley	25.0%	5'250	95'025'000	75'852'000		518'989
		Oats	16.0%	3'360	63'201'600	43'255'296		341'006
		Peas, field	10.0%	2'100	39'249'000	32'558'400		477'960
		Potato protein	4.0%	840	19'219'200	14'902'272		700'140
		Soybeans, extruded	8.0%	1'680	39'217'920	29'772'288		689'934
		Sunflower cake	8.0%	1'680	35'330'400	19'853'568		401'411
		Wheat, soft, animal feed	25.0%	5'250	94'920'000	82'756'800		605'115
Fattening pigs total			99.0%	20'790	397'685'820	308'647'584		3'817'626
Broilers	Bought	Barley	6.0%	84	1'528'554		1'113'902	8'348
		Maize, grain	30.0%	422	7'786'334		6'739'148	34'563
		Peas, field	6.0%	84	1'578'379		1'086'878	19'221
		Potato protein	4.0%	56	1'288'151		900'805	46'926
		Soybeans, extruded	15.0%	211	4'928'530		3'240'154	86'704
		Sunflower cake	7.0%	99	2'071'992		828'600	23'541
		Wheat, soft, animal feed	30.0%	422	7'634'323		6'232'445	48'669
Broilers total			98.0%	1'379	26'816'263		20'141'931	267'973
Laying hens	Own	Cereals FP	0.4%	207	3'731'425			22'124
		Grain legumes FP	0.1%	52	993'011			14'580
		Maize, grain	0.1%	52	954'202		825'871	4'236
	Bought	Barley	4.0%	2'070	37'464'311		27'301'340	204'615
		Maize, grain	35.0%	18'111	333'970'527		289'054'751	1'482'492
		Potato protein	4.0%	2'070	47'358'200		33'117'623	1'725'221
		Soybeans, extruded	8.0%	4'140	96'637'223		63'532'019	1'700'072
		Sunflower cake	10.0%	5'175	108'822'438		43'518'626	1'236'400
		Wheat gluten	8.0%	4'140	97'543'818			3'562'752
		Wheat, soft, animal feed	28.0%	14'489	261'960'396		213'857'049	1'669'998
Laying hens total			97.6%	50'504	989'435'550		671'207'279	11'622'490

Source: FiBL calculation based on Bestman and Wagenaar

Table 63: Netherlands: Feeding practices and resulting amino acid demand 2011 for fattening pigs, broilers, and laying hens

Animal Species	Own or Bought	Crop	CP [kg]	LYS [kg]	MET [kg]	CYS [kg]	MET + CYS [kg]
Fattening pigs	Own	Cereals	44'893	1'384	736	1'090	1'826
		Grain legumes	29'584	1'822	248	395	643
		Maize, grain	8'595	250	179	212	390
	Bought	Barley	518'989	18'787	8'613	12'049	20'661
		Oats	341'006	12'795	5'426	9'996	15'422
		Peas, field	477'960	34'440	4'599	7'560	12'159
		Potato protein	700'140	51'643	15'691	10'517	26'208
		Soybeans, extruded	689'934	42'645	9'744	10'787	20'531
		Sunflower cake	401'411	15'251	9'125	7'254	16'379
		Wheat, soft, animal feed	605'115	14'682	9'416	14'235	23'651
Fattening pigs total			3'817'626	193'699	63'777	74'095	137'872
Broilers	Bought	Barley	8'348	302	139	194	332
		Maize, grain	34'563	1'005	718	851	1'568
		Peas, field	19'221	1'385	185	304	489
		Potato protein	46'926	3'461	1'052	705	1'757
		Soybeans, extruded	86'704	5'359	1'225	1'356	2'580
		Sunflower cake	23'541	894	535	425	961
		Wheat, soft, animal feed	48'669	1'181	757	1'145	1'902
Broilers total			267'973	13'588	4'610	4'979	9'589
Laying hens	Own	Cereals	22'124	682	363	537	900
		Grain legumes	14'580	898	122	195	317
		Maize, grain	4'236	123	88	104	192
	Bought	Barley	204'615	7'407	3'396	4'750	8'146
		Maize, grain	1'482'492	43'105	30'789	36'485	67'274
		Potato protein	1'725'221	127'254	38'665	25'915	64'579
		Soybeans, extruded	1'700'072	105'082	24'010	26'581	50'591
		Sunflower cake	1'236'400	46'975	28'106	22'344	50'450
		Wheat gluten	3'562'752	53'390	54'727	73'190	127'917
		Wheat, soft, animal feed	1'669'998	40'518	25'986	39'287	65'273
Laying hens total			11'622'490	425'435	206'251	229'388	435'639

Source: FiBL calculation based on Bestman and Wagenaar

7.1.9 Sweden

For Sweden, the data were provided by Maria Neil from the Swedish University of Agricultural Sciences (SLU) in Uppsala, based on national data sources. The information on feed composition and feeding practices was provided by Anna Wallenbeck of the Swedish University of Agricultural Sciences (SLU) in Uppsala.

The following information was provided:

- Data on the total organic area (fully converted and in-conversion, (Area; EF [ha]); (JO 16 SM 1202 Skörd för ekologisk och konventionell odling 2011 (Statistical message from Swedish Board of Agriculture: Production of organic and non-organic farming 2011) and Ekologisk växtodling 2011. Sveriges officiella statistik Statistiska meddelanden. JO 10 SM 1203)
- Data on the organic production ([yield] (Skörd för ekologisk och konventionell odling 2011. Sveriges officiella statistik Statistiska meddelanden. JO 10 SM 1202.)
- Total estimated production volume animal feed ([mt], [% share used as animal feed]) (estimates, calculations by Neil)
- Data on livestock
- Feeding practices for pigs (Jonasson, L. 2012. Regional balans för ekologiskt foder. Ekologiska Lantbrukarna. http://ekolantbruk.se/pdf/71032.pdf, and Göransson, L. Foder till ekologiska grisar. http://www.svenskapig.se/fakta-3/ekologisk-grisproduktion)

About 227'000 metric tons of concentrate feed (DM) are needed to feed the organic animals in Sweden. The farmers are able to produce about 183'000 metric tons by themselves. This results in a self-sufficiency rate for concentrate feed (DM) of about 80 percent (Figure 69). When looking at the supply situation for crude protein (CP), the self-sufficiency rate is a bit lower (around 71 percent). Regarding its production capacity, Sweden is placed in the upper mid-range compared with the other ICOPP countries.

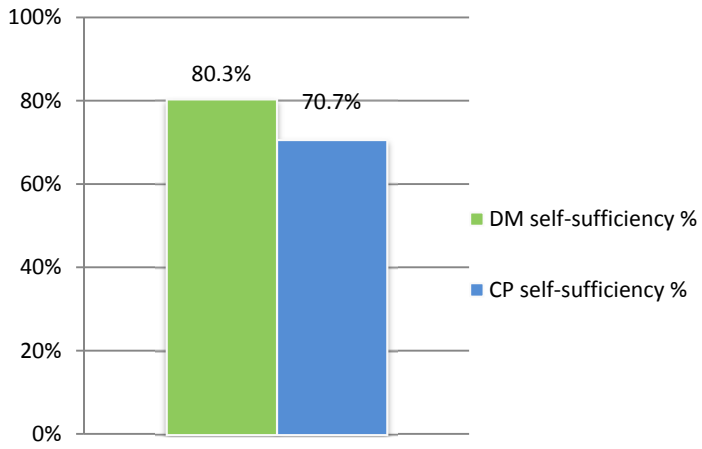


Figure 57: Sweden: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: FiBL calculation based on Neil

Lysine is the most available amino acid; more than 70 percent of the demand can be covered by national feed. The self-sufficiency rate for the sulphur-containing amino acids is a bit less.

As seen in Figure 57, the self-sufficiency in crude protein is lower than the self-sufficiency in concentrate feed. This indicates that, in particular, crops with high protein content have to be

imported, especially crops and secondary feed products that are a good source of methionine and cysteine, the sulphur-containing amino acids (Figure 58).

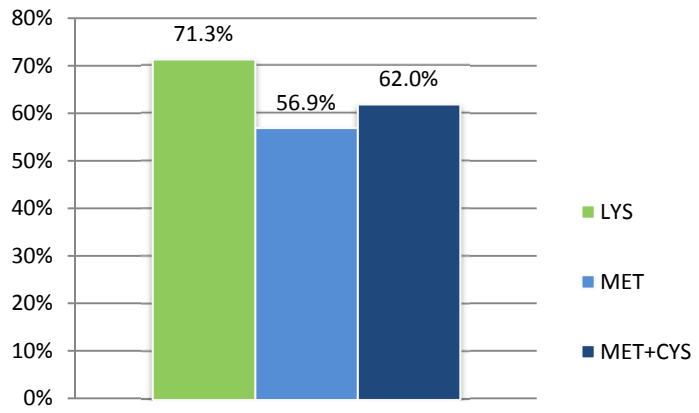


Figure 58: Sweden: Self-sufficiency rate for amino acids 2011

Source: FiBL calculation based on Neil

Figure 59 shows the proportional impact of the different species on the total feed demand. Bovine animals account for the largest share of feed (79 percent), followed by poultry (16 percent) and pigs (5 percent).

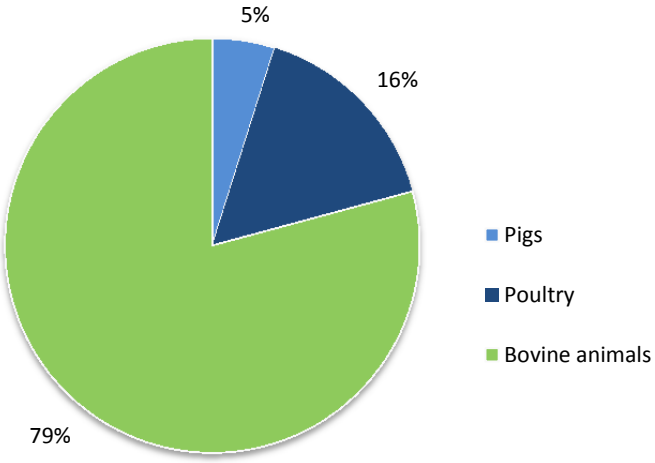


Figure 59: Sweden: Demand (%) for concentrate feed (DM) of the different species 2011

Source: FiBL calculation based on Neil

A similar picture with a slight shift of rations emerges from Figure 60, which describes the demand for crude protein for the respective species. Again, bovine animals have the greatest need (75 percent). The demand for crude protein for poultry and pigs amounts to 19 percent and 6 percent respectively.

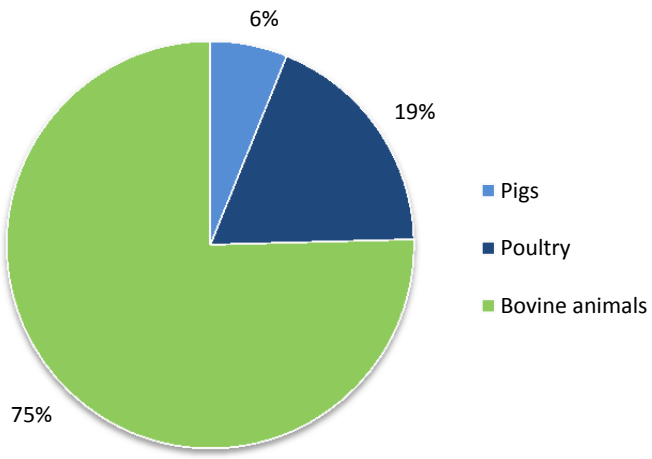


Figure 60: Sweden: Demand (%) for crude protein of the different species 2011

Source: FiBL calculation based on Neil

Compared with the other countries observed in the ICOPP project, Sweden has a relatively low number of dairy cows (about 44'100), but regarding the quantity of suckler cows, it is placed in the middle (Table 64). In the area of poultry and pig production Sweden is nearer the low end.

Table 64: Sweden: Number of organic animals 2011

Animal Species	Category	Indicator	Value
Bovine animals	Dairy cows	Animals [heads]	44'133
	Suckler cows	Animals [heads]	45'183
Pigs	Breeding sows	Animals, places [no]	1'714
		Animals, replacement rate [percent]	52
	Fattening pigs	Animals, slaughtered [no]	27'682
Poultry	Broilers	Animals, slaughtered [no]	176'030
	Laying hens	Animals, places [no]	746'839

Source: Neil, based on national data source

The feed, protein and amino acid demand per animal and type conforms to the demand in the other mentioned European countries (Table 65). Dairy cows and suckler cows are the only exceptions. The need for concentrate feed (2'275 kg DM, and 1'766 kg DM respectively) and crude protein (332 kg and 223 kg respectively) per cow and year is, along with the assumed demand data for the animals in Finland, the highest within the observed countries, probably due to the focus on high input dairy production systems and high demanding dairy breeds.

Table 65: Sweden: Total need of concentrate feed, protein and amino acid per animal species and indicator 2011

Animal Species	Category	Indicator	Total Feed DM [kg]	Total ME [MJ]	Total VES [MJ]	Total Crude Protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met+Cys [kg]
Bovine[16]	Dairy cows*	per head and year	2275	33670		332	14.48	5.53	14.46
	Suckler cows**	per LSU and year	1765	27243		223	7.48	3.66	8.85
Pigs	Breeding sows***	per litter	671	8330	8680	110	5.13	1.88	3.74
	Fattening pigs	per number slaughtered	280	4160	4333	52	2.63	0.78	1.55
	gilts	per head	254	3536	3684	39	2.33	0.75	1.49
	Weaners	per head	27.3	392.6	409	5.2	0.36	0.12	0.23
Poultry	Broilers	per number slaughtered	4.8	69		1.1	0.05	0.02	0.04
	Laying hens	per place and year	41.8	477.2		6.9	0.30	0.14	0.27
	Rearing pullets	per head	6.8	80.3		1.1	0.06	0.03	0.05

Source: FiBL calculation based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand) and inputs from Neil based on national data sources
* Dairy cows: 40% protein and concentrate feed
** Suckler cows: 30% protein and concentrate feed
***Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between

In the northern countries like Finland and Sweden, oats are the most produced energy crop (Table 66). Sweden produces about 44'000 metric tons of it, followed by wheat (34'000 metric tons) and barley (25'000 metric tons). Field beans, with about 20'000 metric tons of production, also play a major role in crop cultivation. Within the project, only France and Germany produce more beans (each about 23'000 metric tons).

Table 66: Sweden: Estimated concentrate feed production 2011

Crop	Production EF [mt]*	Production DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley	28'800	25'056	453'514	362'009	330'489	2'476'911	89'663	57'503	41'104	98'608
Beans, field	23'000	20'010	383'192	286'991	234'517	5'922'960	359'380	73'636	49'225	122'861
Maize, grain	77	67	1232	1'067	1'066	5'469	159	134	114	248
Mixed cereal grains	26'500	23'055	419'832	337'304		2'371'207	78'485	60'299	37'567	97'866
Oats	50'800	44'196	831'327	568'962	531'678	4'485'452	168'298	131'483	71'377	202'860
Peas, field	3'600	3'132	58'537	48'559	40'309	712'843	51'365	11'275	6'859	18'134
Rye	3'680	3'202	57'181	49'422	39'220	307'514	10'994	7'946	4'708	12'654
Triticale	8'000	6'960	124'932	108'242	99'876	719'977	25'616	18'457	12'601	31'059
Wheat, soft, animal feed	38'560	33'547	606'533	528'811	495'157	3'866'650	93'815	90'963	60'167	151'130
Cereals, no details	26'880	23'386	423'279	337'875		2'311'784	83'487	53'669	38'364	92'034
Total	209'897	182'610	3359'558	2'629'242	1'772'311	23'180'767	961'262	505'369	322'085	827'455

Source: FiBL calculation based on Neil based on national data sources
*Production EF: Estimated production of feed

[16] Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

As seen in Table 67, most concentrate feed is needed for bovine animals (180'000 metric tons). About a fifth of their feed amount is required for poultry and approximately a third of poultry's' demand is required for pigs. When looked at the crude protein and amino acid demand, relations are shift a little, but bovine animals still have the highest demand, followed by poultry and pigs (Table 68).

Table 67: Sweden: Concentrate feed, energy and crude protein demand 2011

Animal Species	Category	Livestock Indicator	heads/no	feed DM per head/no [kg]	Total feed DM [mt]	Total ME [MJ]	Crude Protein [mt]
Pigs	Breeding sows****	Litters [no]	3'428	671.00	2'300	28'555'240	377
	Fattening pigs	Animals, slaughtered [no]	27'682	280.00	7'751	115'157'120	1'439
	Gilts*	Animals [heads]	891	254.35	227	3'152'226	35
	Weaners*	Animals [heads]	29'343	27.38	803	11'522'084	154
Pigs total			61'344	1'232.72	11'081	158'386'670	2'006
Poultry	Broilers	Animals, slaughtered [no]	176'030	4.87	857	12'146'070	188
	Laying hens	Animals, places [no]	746'839	41.86	31'263	356'391'571	5'170
	Rearing pullets	Animals [heads]	597'471	6.86	4'101	47'982'912	698
Poultry total			1'520'340	53.59	36'221	416'520'553	6'057
Bovine animals* **	Dairy cows	Animals [heads]	44'133	2'275.00	100'403	1'485'958'110	14'652
	Suckler cows	LSU [no]	45'183	1'765.50	79'771	1'230'925'918	10'088
Bovine animals total			89'316	4'040.50	180'174	2'716'884'028	24'740
Totals			1'671'001	5'326.82	227'476	3'291'791'250	32'804

Source: FiBL calculation based on Neil

* Gilts: calculated from average replacement rate of breeding sows = 52%
** Weaners: calculated from number of slaughtered fattening pig plus additional 6% for gilts, losses, etc.
*** Bovine animals: only protein and energy feed, Dairy cows: 40% of total DM, Suckler cows: 30% of total DM.
**** Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between; 2 litters per year

Table 68: Sweden: Total amino acid demand 2011

Animal Species	Category	Crude Protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Pigs	Breeding sows	377	17'586	6'445	12'821
	Fattening pigs	1'439	72'804	21'647	42'907
	Gilts	35	2'078	669	1'327
	Weaners	154	10'593	3'374	6'808
Pigs total		2'006	103'061	32'136	63'862
Poultry	Broilers	188	9'154	3'345	7'393
	Laying hens	5'170	224'799	106'051	197'912
	Rearing pullets	698	34'653	14'937	28'081
Poultry total		6'057	268'605	124'332	233'387
Bovine animals	Dairy cows	14'652	638'869	244'276	638'207
	Suckler cows	10'088	337'744	165'371	399'691
Bovine animals total		24'740	976'614	409'647	1'037'898
Total		32'804	1'348'280	566'115	1'335'147

Source: FiBL calculation based on Neil

According to the experts rough estimates, feeding components for fattening pigs are mainly home-grown, containing primarily barley (45 percent) and oats (25 percent). Peas and beans serve as protein sources (in each case 10 percent) (Table 69 and Table 70). Purchased protein sources are soybeans (3 percent) and fish meal (2 percent).

Table 69: Sweden: Feeding practices and derived calculated feed, energy and protein consumption 2011 for fattening pigs (proportions of diets (%) are estimates of main feeding components)

Animal Species	Animal Category	Own or Bought	Crop	Share in Feed %	DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	CP [kg]
Pigs	Fattening pigs	Own	Barley	45.0%	3'488	63'131'569	50'393'642	344'800
			Beans, field	10.0%	775	14'843'088	11'116'737	229'428
			Oats	25.0%	1'938	36'448'889	24'945'690	196'661
			Peas, field	10.0%	775	14'486'544	12'017'088	176'412
			Rape and turnip rape	5.0%	388	10'618'815	7'701'354	68'255
		Bought	Fish meal	2.0%	155			
			Soybeans	3.0%	233	5'373'741		94'639
			Fattening pigs total	100.0%	7'751	144'902'647	106'174'510	1'110'195

Source: FiBL calculation based on Neil

Table 70: Sweden: Feeding practices and derived calculated amino acid consumption 2011 for fattening pigs

Animal Type	Own or Bought	Crop	CP [kg]	LYS [kg]	MET [kg]	CYS [kg]	MET + CYS [kg]
Fattening pigs	Own	Barley	344'800	12'482	5'722	8'005	13'727
		Beans, field	229'428	13'921	1'907	2'852	4'759
		Oats	196'661	7'379	3'129	5'765	8'894
		Peas, field	176'412	12'712	1'697	2'790	4'488
		Rape and turnip rape	68'255	4'253	1'476	1'841	3'317
	Bought	Fish meal					
		Soybeans	94'639	5'850	1'337	1'479	2'816
		Fattening pigs Total	1'110'195	56'596	15'268	22'733	38'001

Source: FiBL calculation based on Neil

7.1.10 Switzerland[17]

The data for Switzerland is based on a number of sources: data from the certifiers collected by FiBL (area and livestock numbers) and Bio Suisse (for feed component and concentrate feed production) as well as estimates by the Research Institute of Organic Agriculture (FiBL).

The following information was provided:

- Total estimated production volume animal feed [mt] (Bio Suisse)
- Data on Livestock (BLW-Statistik, Certification bodies Bioinspecta and BTA, Bio Suisse, estimates FiBL)
- Feeding practices for pigs, laying hens and broilers (estimates and calculations FiBL)

Switzerland has a relatively low self-sufficiency rate. In 2011, around 9'000 metric tons of concentrate feed were produced in the country, but demand was almost seven times higher. This corresponds to a self-sufficiency rate of approximately 15 percent for total concentrate feed and approximately 11 percent for crude protein (Figure 61).

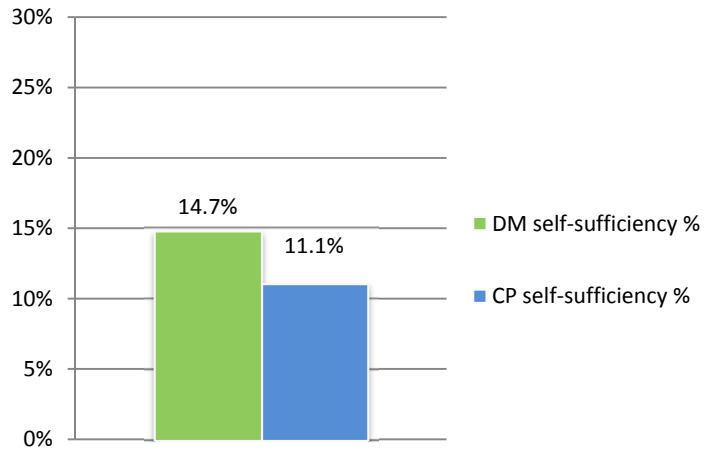


Figure 61: Switzerland: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: FiBL calculation based on national data sources

The self-sufficiency rate for the sulphur containing amino acids (Met +Cys) is slightly better than for lysine. In summary, it can be said that the amino acid self-sufficiency rate is rather low (Figure 62).

[17] The calculations for Switzerland were co-funded by the Migros-Genossenschaftsbund (MGB), Zürich, Switzerland.

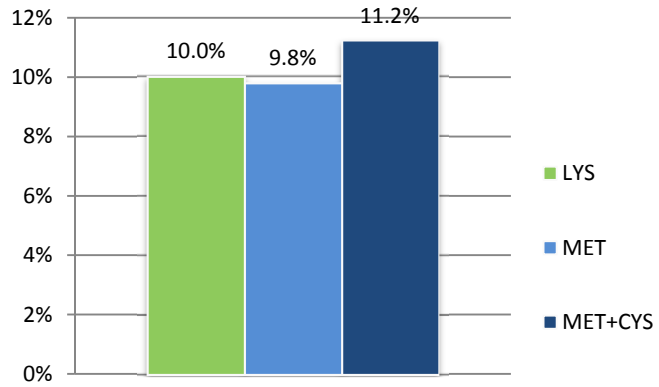


Figure 62: Switzerland: Self-sufficiency rate for amino acids 2011

Source: FiBL calculation based on national data sources

Figure 63 shows the proportional impact of the different species on the total feed demand. Bovine animals account for the largest share of concentrate feed demand (55 percent), followed by poultry (30 percent) and pigs (15 percent).

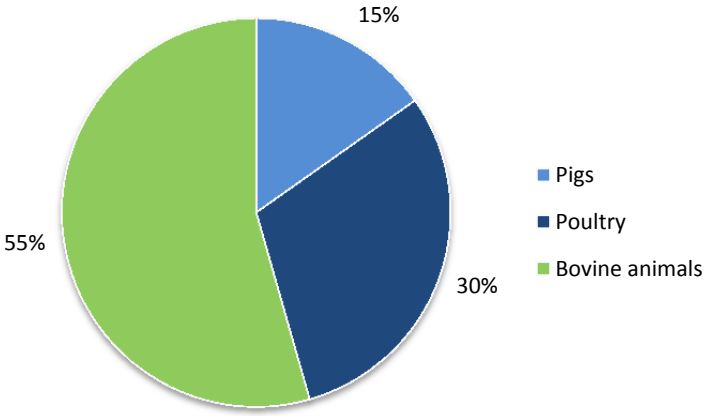


Figure 63: Switzerland: Demand (%) for concentrate feed (DM) of the different species 2011

Source: FiBL calculation based on national data sources

A similar picture with a slight shift of relations emerges from Figure 64, which shows the amount of the demand for crude protein of the respective species. Bovine animals still have the greatest need (46 percent). The demand for crude protein of poultry and pigs amounts to 35 percent and 19 percent, respectively.

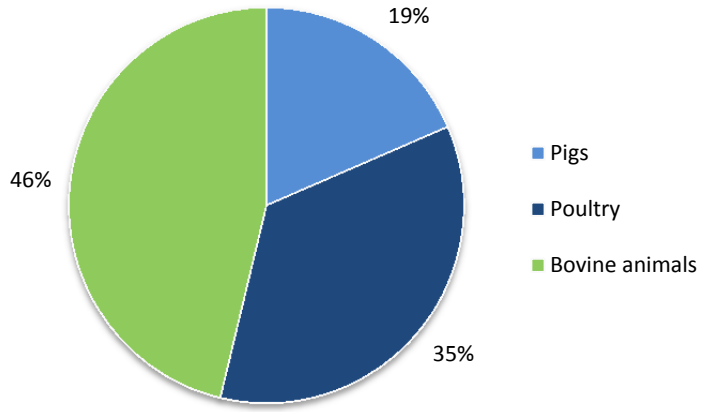


Figure 64: Switzerland: Demand (%) for crude protein of the different species 2011

Source: FiBL calculation based on national data sources

Compared to the other observed countries, Switzerland has a relatively low organic pig and poultry production (Table 71). The high number of bovine animals is due to the fact that large parts of Switzerland, with its alpine and mountainous regions, are not suitable for crop cultivation and are best suited to grassland-based ruminant production.

Table 71: Switzerland: Number of organic animals 2011

Animal Species	Category	Indicator	Numbers
Bovine animals	Dairy cows	Animals [heads]	84'537
	Suckler cows	Animals [heads]	20'605
Pigs	Breeding sows	Animals, places [no]	1'500
	Fattening pigs	Animals, slaughtered [no]	23'000
Poultry	Broilers	Animals [places [no]	90'278
	Laying hens	Animals, places [no]	328'733

Source: National data sources

In Switzerland, less demanding dual purpose dairy cattle, which are adapted to the low input management systems, are widely used. Also, national organic regulations limit concentrate use for ruminants at 10 percent. This is reflected by low nutrient requirements (Table 72). The nutritive demand of other species does not deviate from the respective requirements of animals from other countries.

Table 72: Switzerland: Total need of concentrate feed, protein and amino acid per animal species and indicator 2011

Animal Species	Category	Indicator	Total Feed DM [kg]	Total DE [MJ]	Total ME [MJ]	Total Crude Protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met + Cys [kg]
Bovine[18]	Dairy cows*	per head and year	589		9081	74	2.49	1.22	2.95
	Suckler cows**	per LSU and year	294		4540	37	1.25	0.61	1.47
Pigs	Breeding sows	per litter	671	8680	8330	110	5.13	1.88	3.74
	Fattening pigs	per number slaughtered	280	4333	4160	52	2.63	0.78	1.55
	gilts	per head	254	3684	3537	40	2.33	0.75	1.49
	Weaners	per head	27.4	409	393	5.3	0.36	0.12	0.23
Poultry	Broilers	per number slaughtered	4.9		69	1.1	0.05	0.02	0.04
	Laying hens	per place and year	41.9		477	6.9	0.30	0.14	0.27
	Rearing pullets	per head	6.9		80	1.2	0.06	0.03	0.05

Source: Source: FiBL calculations based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand)
* dairy cows: 10% protein and concentrate feed
** Suckler cows: 5% protein and concentrate feed
* Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between; 2 litters per year

Wheat and barley are, with about 2'000 metric tons of production (DM), the most frequently cultivated organic crops, followed by maize and triticale (Table 73). Peas and beans are the prevalently grown protein crops, with about 370 and 280 metric tons of production (DM), respectively.

Table 73: Switzerland: Estimated concentrate feed production 2011

Crop	Production EF [mt]*	Production DM [mt]	Gross Energy [GJ]	ME pigs [GJ]	ME poultry [GJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley	2'300	2'001	36'218	28'910	26'393	197'809	7'161	4'592	3'283	7'875
Beans, field	317	276	5'281	3'955	3'232	81'634	4'953	1'014	678	1'693
Maize, grain	2'014	1'752	32'310	27'973	27'965	143'425	4'170	3'529	2'979	6'508
Oats	471	410	7'708	5'275	4'930	41'588	1'560	1'219	662	1'881
Peas, field	428	372	6'959	5'773	4'792	84'749	6'107	1'340	815	2'156
Rye	720	626	11'188	9'670	7'673	60'166	2'151	1'554	921	2'476
Spelt	283	246	4'535	2'893		28'608	776	696	423	1'120
Triticale	1'315	1'144	20'536	17'792	16'417	118'346	4'211	3'034	2'071	5'105
Wheat, soft, animal feed	2'450	2'132	38'538	33'599	31'461	245'677	5'961	5'779	3'823	9'602
Total	10'298	8'959	163'273	135'842	122'863	1'002'001	37'050	22'761	15'655	38'417

Source: FiBL calculation based on national data sources
*Production EF: Estimated production of feed

Tables 74 and 75 show the total demand for concentrate feed, crude protein, energy, and amino acids. Most of the concentrate feed (DM) is needed for bovine animals (33'000 metric tons), followed by the amount for poultry (18'450 metric tons) and pigs (9'250 metric tons). When the crude protein and amino acid demand is considered, relations shift, but bovine animals still have the highest demand, followed by poultry and pigs.

[18] Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

Table 74: Switzerland: Concentrate feed, energy and crude protein demand 2011

Animal	Category	Live-	heads/no	Concentrate	Total feed	Total ME	Crude
Pigs	Breeding sows	Litters	3'000	671.00	2'013	24'990'000	330
	Fattening pigs	Ani-	23'000	280.00	6'440	95'680'000	1'196
	Gilts*	Animals	525	254.35	134	1'856'789	21
	Weaners**	Animals	24'380	27.38	667	9'573'295	128
Pigs total			50'905	1'232.72	9'254	132'100'083	1'675
Poultry	Broilers	Ani-	486'000	4.87	2'367	33'534'000	520
	Laying hens	Ani-	328'733	41.86	13'761	156'871'388	2'276
	Rearing pullets	Animals	338'595	6.86	2'324	27'192'564	396
Poultry total			1'153'328	53.59	18'452	217'597'951	3'192
Bovine ani-	Dairy cows	Animals	48'005	588.50	28'251	435'933'405	3'573
mals* **	Suckler cows	LSU [no]	16'484	294.00	4'846	74'837'360	613
Bovine animals total			64'489	882.50	33'097	510'770'765	4'186
Total			1'268'722	2'168.82	60'803	860'468'799	9'053

Source: FiBL calculation based on national data sources

* Gilts: calculated from average replacement rate of breeding sows = 35%
** Weaners: calculated from number of slaughtered fattening pig plus additional 6% for gilts, losses, etc.
*** Bovine animals: only protein and concentrate feed, Dairy cows: 10% of total DM, Suckler cows: 5% of total DM.
ME is the theoretical amount of metabolizable energy for pigs.

Table 75: Switzerland: Total amino acid demand 2011

Animal Species	Category	Crude Protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Pigs	Breeding sows	330	15'390	5'640	11'220
	Fattening pigs	1'196	60'490	17'986	35'650
	Gilts	21	1'224	394	782
	Weaners	128	8'801	2'804	5'656
Pigs total		1'675	85'905	26'824	53'308
Poultry	Broilers	520	25'272	9'234	20'412
	Laying hens	2'276	98'949	46'680	87'114
	Rearing pullets	396	19'639	8'465	15'914
Poultry total		3'192	143'859	64'379	123'440
Bovine animals	Dairy cows	3'573	119'628	58'566	141'567
	Suckler cows	613	20'539	10'055	24'297
Bovine animals total		4'186	140'168	68'621	165'864
Total		9'053	369'932	159'824	342'612

Source: FiBL calculation based on national data sources

According to the rough estimates by the consulted experts, most of the feed used for fattening pigs and poultry is purchased (Table 76 and Table 77). Bought energy components are barley and wheat, which account for about 25 percent and 8 percent, respectively, of the diet. Purchased protein components are peas (16 percent), soy cake (10 percent), and potato protein (4 percent). Home-grown barley is also used, as well as triticale and some wheat. For laying hens, the feeding components are mainly purchased soy cake (35 percent), maize (30 percent), and wheat (15 percent).

Table 76: Switzerland: Feeding practices and derived calculated feed, energy and protein consumption 2011 for fattening pigs and laying hens (proportions of diets (%) are estimates of main feeding components

Animal Species	Category	Own or Bought	Crop	Share in Feed %	DM [mt]	Gross Energy [MJ]	ME pigs [MJ]	ME poultry [MJ]	Crude protein [kg]
Pigs	Fattening pigs	Own	Barley	25.0%	1'610	29'141'000	23'261'280		159'157
			Triticale	10.0%	644	11'559'800	10'015'488		66'619
			Wheat, soft, animal feed	2.0%	129	2'328'704	2'030'300		14'845
		Bought	Barley	25.0%	1'610	29'141'000	23'261'280		159'157
			Peas, field	16.0%	1'030	19'258'176	15'975'322		234'519
			Potato protein	4.0%	258	5'893'888	4'570'030		214'710
			Soy cake	10.0%	644	13'350'120	10'182'413		313'950
			Wheat, soft, animal feed	8.0%	515	9'314'816	8'121'201		59'382
	Fattening pigs total			100.0%	6'440	119'987'504	97'417'313		1'222'338
Poultry	Laying hens	Own	Barley	5.0%	688	12'453'491		9'075'223	68'016
			Maize, grain	2.0%	275	5'074'970		4'392'436	22'528
			Wheat, soft, animal feed	5.0%	688	12'439'730		10'155'443	79'303
		Bought	Maize, grain	30.0%	4'128	76'124'543		65'886'535	337'916
			Soy cake	35.0%	4'816	99'841'219		53'123'427	2'347'930
			Sunflower	8.0%	1'101				
			Wheat, soft, animal feed	15.0%	2'064	37'319'190		30'466'330	237'910
	Laying hens total			100.0%	13'761	243'253'143		173'099'395	3'093'603

Source: FiBL calculation based on national data sources

Table 77: Switzerland: Feeding practices and derived calculated amino acid consumption 2011 for fattening pigs, broilers and laying hens

Animal	Category	Own or Bought	Crop	CP [kg]	LYS [kg]	MET [kg]	CYS [kg]	MET + CYS
Pigs	Fattening	Own	Barley	159'157	5'761	2'641	3'695	6'336
			Triticale	66'619	2'370	1'166	1'708	2'874
			Wheat, soft, animal	14'845	360	231	349	580
		Bought	Barley	159'157	5'761	2'641	3'695	6'336
			Peas, field	234'519	16'899	2'257	3'709	5'966
			Potato protein	214'710	15'837	4'812	3'225	8'037
			Soy cake	313'950	19'326	4'418	4'888	9'306
			Wheat, soft, animal	59'382	1'441	924	1'397	2'321
	Fattening pigs total			1'222'338	67'756	19'090	22'667	41'756
Poultry	Laying hens	own	Barley	68'016	2'462	1'129	1'579	2'708
			Maize, grain	22'528	655	468	554	1'022
			Wheat, soft, animal	79'303	1'924	1'234	1'866	3'100
		bought	Maize, grain	337'916	9'825	7'018	8'316	15'334
			Soy cake	2'347'930	144'536	33'040	36'555	69'595
			Sunflower					
			Wheat, soft, animal	237'910	5'772	3'702	5'597	9'299
	Laying hens total			3'093'603	165'175	46'590	54'468	101'058

Source: FiBL calculation based on national data sources

7.1.11 United Kingdom

Data were provided by Catherine Gerrard and Rebecca Nelder of the Organic Research Centre, Elm Farm and reviewed by Katherine Leech, Bruce Pearce, and Jo Smith of the Organic Research Centre, Elm Farm and Ruth Clements of FAI, Oxford. The data were based on Eurostat and national data sources including expert estimates.

The following information was provided:

- Data on the total organic area (fully converted and in-conversion, (Area; EF [ha]);
- Data on the total organic production ([yield], [mt])
- Total estimated production volume animal feed ([mt])
- Data on Livestock
- Feeding practices for laying hens and broilers

All data on crop areas are from Eurostat. Yields are generally from "The Organic Farm Management Handbook 2011/12", published by the Organic Research Centre Elm Farm (Lampkin et al. 2011). Grass and forage yields were estimated based on data from "Grass: its production and utilisation, 3rd Edition" edited by Alan Hopkins (2000), Blackwell Science. Estimates of import (and sometimes export) are from Saxon Agriculture some of which are based on figures from the Agricultural Industries Confederation (AIC). The proportion of crop production going as feed is assumed as 60 percent for cereals and 100 percent for legume crops and roughage (as per an Organic Revision estimate for UK carried out in 2004). Where possible amounts produced in the UK as animal feed were compared with figures from the Agricultural Industries Confederation (AIC) for organic feed material consumption in UK manufactured concentrate feed as a data check. Expert estimates were also used in situations where detailed data were sparse, e.g. for proportions of tubers and roots produced that went for animal feed rather than human consumption.

The numbers of animals are from Eurostat; other livestock data and feeding practices are from the Organic Farm Management Handbook (Lampkin et al. 2011), certification bodies, experts' opinion and industry.

According to the estimates, about 330’000 metric tons of concentrate feed (DM) are needed to feed the organic animals in the United Kingdom. The farmers are able to produce about 141’000 metric tons by themselves. This results in a self-sufficiency rate for concentrate feed (DM) of about 43 percent (Figure 65). When the supply situation for crude protein (CP) is considered, the self-sufficiency rate is, at around 30 percent, further reduced. Regarding its production capacity, the United Kingdom is placed in the lower midrange compared with the other evaluated countries.

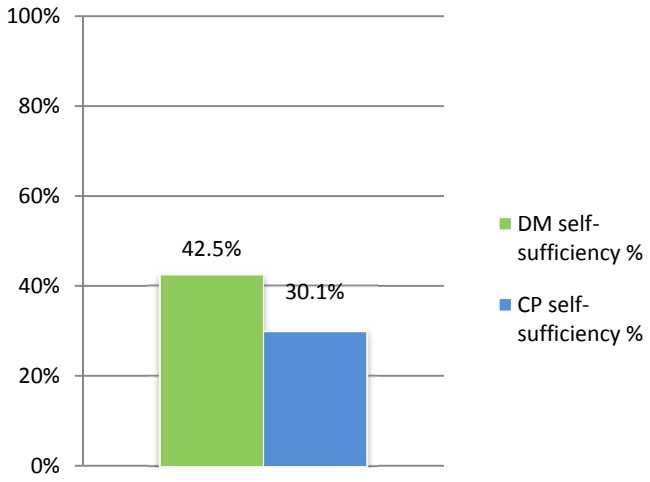


Figure 65: UK: Self-sufficiency rate for concentrate feed (DM) and crude protein (CP) 2011

Source: FiBL calculations based on data provided by the Organic Research Centre

In accordance with the situation regarding the supply of crude protein, the self-sufficiency rate for the amino acids is rather low and lies between 14 and 40 percent (Figure 69). As already seen in Figure 68, the self-sufficiency in crude protein is lower than the self-sufficiency in overall concentrate feed (DM). This indicates that crops and secondary feed products with high protein content have to be imported.

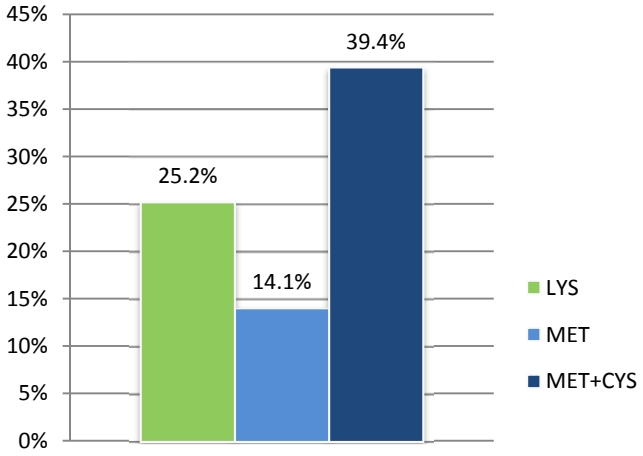


Figure 66: UK: Self-sufficiency rate for amino acids 2011

Source: FiBL calculations based on data provided by the Organic Research Centre

Figure 70 shows the proportional impact of the different agricultural species on the total feed demand. Bovine animals account for the largest share of feed (67 percent), followed by poultry (22 percent) and pigs (11 percent).

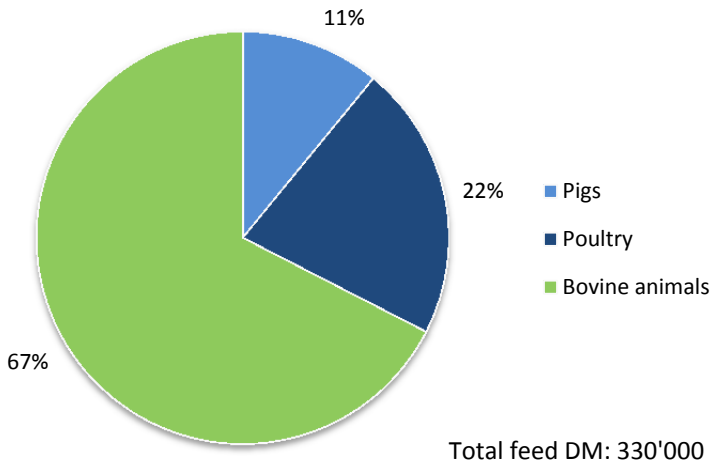


Figure 67: UK: Demand (%) for concentrate feed (DM) of the different species 2011

Source: FiBL calculations based on data provided by the Organic Research Centre

A similar picture emerges when the share of the demand for crude protein for the respective species is considered (Figure 71). Compared with Figure 70, the proportions did not change considerably. Bovine animals again demand 67 percent of the whole protein amount. The share of the demand of poultry and pigs of the total protein amount is 23 percent and 10 percent, respectively.

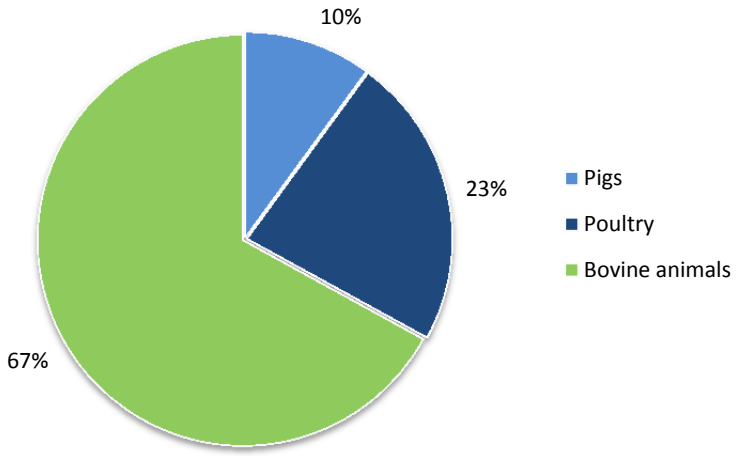


Figure 68: UK: Demand (%) for crude protein of the different species 2011

Source: FiBL calculations based on data provided by the Organic Research Centre

With about 146’000 animals, the United Kingdom has the largest number of dairy cows within the observed countries (Table 77). With regards to organic broiler production, the U.K. produces

about 1.7 million animal places or 7 million slaughtered animals per year (calculated by multiplying the number of places by 4.2), taking a leading role after France. The U.K. is also one of the leaders in pig production.

Table 78: United Kingdom: Organic animals 2011

Animal Species	Category	Indicator	
Bovine animals	Bovine animals aged between 1 and 2 years	Animals, places [no]	98'072
	Dairy cows	Animals, places [no]	146'137
	Bovine animals of 2 years and over, no details	Animals, places [no]	90'550
Pigs	Breeding sows	Animals, places [no]	5'642
	Fattening pigs	Animals, places [no]	37'843
	Pigs, other	Animals, places [no]	9'155
Poultry	Broilers*	Animals, places [no]	1'690'800
	Laying hens**	Animals, places [no]	1'062'998
	Poultry, other*	Animals, places [no]	84'352

Source: Organic Research Centre based on national data sources
*based on data from certification inspections of farms, amalgamation of counted animals, roughly approximate number of places.
** laying hens: places for rearing pullets are included

The feed, protein, and amino acid demand per animal and type conforms to the demand in the other mentioned European countries (Table 79). Only dairy cows and fattening pigs represent an exception. The need for concentrate feed (1525 kg DM) and crude protein (274 kg) per dairy cow and year lies in the upper half of the observed countries. Possibly, this is due to the focus on high input dairy production systems and high nutrient demand dairy breeds. As organic fattening pigs in the UK have a lower age and lower weight at slaughter (~182 days instead of ~ 220 days and 100kg instead of about 125 kg), the feed and protein requirement was lowered.

Table 79: United Kingdom: Total concentrate feed, protein and amino acid need from concentrate per animal type and indicator 2011

Animal Species	Category	Indicator	Total Feed DM [kg]	Total ME [MJ]	Total DE [MJ]	Total Crude Protein [kg]	Total Lys [kg]	Total Met [kg]	Total Met+Cys [kg]
Bovine	Dairy cows*	per head and year	1'525	23'533		274	12.70	9.74	5.90
Pigs	Breeding sows**	per litter	671	8'330	8'680	110	5.13	1.88	3.74
	Fattening pigs	per number slaughtered	236	3'366	3'505	38	2.24	0.72	1.43
	Gilts	per head	254	3'537	3'684	39	2.33	0.75	1.49
	Weaners	per head	27	393	409	5.2	0.36	0.12	0.23
Poultry	Broilers	per number slaughtered	4.8	69		1.1	0.05	0.02	0.04
	Laying hens	per place and year	41.8	477		6.9	0.30	0.14	0.27
	Rearing pullets	per head	6.8	80		1.1	0.06	0.03	0.06

Source: FiBL calculations based on different sources (see also chapter 6.4.2 Calculation of concentrate feed, crude protein, and essential amino acid demand) and inputs from the Organic Research Centre based on national data sources

*Dairy cows: only the amount of protein and energy feed is shown in the table (mainly consisting of grains and leguminous); ME is the hypothetical amount of metabolizable energy for pigs.
**Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between

Wheat (about 49'000 metric tons of DM) and barley (about 36'000 metric tons of DM) are the most frequently produced crops in organic agriculture in the UK (Table 79). Like in the Northern countries, maize plays a minor role. Peas and rapeseed are produced as a protein source (about 3'300 and 270 metric tons of DM respectively)

Table 80: United Kingdom: Estimated concentrate feed production 2011

Crop	Production EF [mt]*	Production DM [mt]	Gross Energy [GJ]	ME pigs [GJ]	ME poultry [GJ]	CP [kg]	LYS [kg]	CYS [kg]	MET [kg]	MET+ CYS [kg]
Barley	41'215	35'857	649016	518'065	472'957	3'544'666	128'315	82'292	58'824	141'116
Beans, field	16'071	13'982	267751	200'532	163'866	4'138'604	251'113	51'452	34'395	85'848
Linseed	45	41	1105	742	650	7'932	306	150	157	308
Maize, grain	832	724	13349	11'557	11'554	59'257	1'723	1'458	1'231	2'689
Oats	26'969	23'463	441336	302'051	282'258	2'381'245	89'347	69'802	37'893	107'695
Peas, field	3'745	3'258	60895	50'514	41'932	741'555	53'434	11'729	7'135	18'865
Rapeseed	282	267	7327	5'314	5'731	47'099	2'935	1'270	1'018	2'289
Rye	1'117	972	17359	15'004	11'907	93'357	3'338	2'412	1'429	3'842
Sugar beet	399	92		281		1'203	62	21	14	35
Triticale	11'074	9'634	172931	149'828	138'248	996'592	35'458	25'549	17'442	42'992
Wheat, animal feed	56'700	49'329	891868	777'583	728'096	5'685'661	137'949	133'755	88'472	222'227
Cereals, no details	1'687	1'468	26568			145'106	5'240	3'368	2'408	5'777
Potatoes	3'424	753	12504	9'921		59'991	2'977	1'056	916	1'972
Carrots	2'147	258		324		2'962	216	46	46	93
Total	169'130	140'852	2574514	2'072'847	1'857'199	17'986'396	716'439	385'795	252'619	638'414

Source: Organic Research Centre based on national data sources

* Production EF: "Estimated feed production"; based on production areas multiplied by estimated average yields and estimated percentage for feed production.

With about 223'000 metric tons (DM) concentrate feed required, bovine animals represent the greatest demand, followed by poultry, which need 71'000 metric tons of concentrates (Table 81). Pig production requires approximately half as much as poultry. When the crude protein and amino acid demand are considered, a similar picture emerges. Bovine animals still have the highest demand, followed by poultry and pigs (Table 82).

Table 81: United Kingdom: Protein demand 2011

Animal Species	Category	Livestock Indica-	heads/no	feed DM per	Total feed	Total ME [MJ]	Crude
Pigs	Breeding	Litters [no]	11'284	671.00	7'572	93'995'720	1'241
	Fattening pigs	Animals, slaugh-	105'960	234.62	24'860	356'620'322	4'068
	Gilts**	Animals [heads]	2'370	254.35	603	8'380'801	94
	Weaners***	Animals [heads]	112'318	27.38	3'075	44'103'918	591
Pigs total			231'932	1'187.34	36'109	503'100'761	5'994
Poultry	Broilers*****	Animals, slaugh-	7'101'360	4.87	34'584	489'993'840	7'598
	Laying hens	Animals, places	752'831	41.86	31'514	359'251'116	5'212
	Rearing	Animals [heads]	775'351	6.86	5'322	62'268'418	906
Poultry total			8'629'542	53.59	71'419	911'513'374	13'717
Bovine	Dairy cows	Animals [heads]	146'137	1'525.00	222'859	3'439'042'021	40'042
Bovine animals total			146'137	1'525.00	222'859	3'439'042'021	40'042
Total					330'387	4'853'656'156	59'752

Source: Organic Research Centre based on national data sources*Breeding sows: per litter; includes 114 days pregnancy, 42 days suckling, 7 days in between; 2 litters per year
**Gilts: calculated from average replacement rate of breeding sows = 42%
***Weaners: calculated from number of slaughtered fattening pig plus additional 6% for gilts, losses, etc.
****Bovine animals: only protein and energy feed shown in the table
***** Broilers: calculated from approximate number of places multiplied by 4.2

Table 82: United Kingdom, amino acid demand 2011

Animal Species	Category	Crude Protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Pigs	Breeding sows	1'241	57'887	21'214	42'202
	Fattening pigs	4'068	237'245	76'503	151'735
	Gilts	94	5'526	1'780	3'528
	Weaners	591	40'547	12'917	26'058
Pigs total		5'994	341'205	112'414	223'524
Poultry	Broilers	7'598	369'271	134'926	298'257
	Laying hens	5'212	226'602	106'902	199'500
	Rearing pullets	906	44'970	19'384	36'441
Poultry total		13'717	640'843	261'212	534'199
Bovine animals	Dairy cows	40'042	1'855'355	1'422'790	861'770
Bovine animals total		40'042	1'855'355	1'422'790	861'770
Total		59'752	2'837'404	1'796'415	1'619'492

Source: Organic Research Centre based on national data sources

The values in Table 83 are only approximate estimates provided by members of the U.K. organic poultry industry.

Feeding components for poultry are believed to be almost solely purchased; in the diets for broilers only a minimal amount of home-grown oats, peas and wheat (each 1 percent) is used (Table 83 and Table 84). The majority of the diet, 63 percent, consists of purchased wheat. Sunflower cake (14 percent) and soybeans (11 percent) are used as protein sources.

[19] Concerning the amino acids required by bovines, it should be noted that, other than for pigs and poultry, the numbers given here do not necessarily represent the quantities of amino acids which have to be supplied via feed. The protein present in feedstuffs is converted into microbial protein by the ruminal microbiota which are the ultimate suppliers of amino acids, provided that sufficient amounts of protein are present in the diet.

Table 83: United Kingdom: Feeding practices and derived calculated feed, energy and protein consumption 2011 for broilers and laying hens (proportions of diets (%) are estimates for the main feeding components)

Animal Species	Own or Bought	Crop	Share in Feed %	DM [mt]	Gross Energy [MJ]	ME poultry [MJ]	CP [kg]
Broilers	Own	Oats	1.0%	346	6'505'180	4'160'410	35'099
		Peas, field	1.0%	346	6'463'679	4'450'912	78'712
		Wheat, soft, animal feed	1.0%	346	6'252'719	5'104'543	39'861
	Bought	Soybeans	11.0%	3'804	87'915'029		1'548'309
		Sunflower cake	14.0%	4'842	101'821'103	40'718'758	1'156'853
		Wheat, soft, animal feed	63.0%	21'788	393'921'302	321'586'195	2'511'248
		Broilers total	91.0%	31'471	602'879'011	376'020'818	5'370'083
Laying hens	Bought	Soybeans	11.0%	3'466	80'110'519		1'410'860
		Sunflower cake	14.0%	4'412	92'782'105	37'104'018	1'054'156
		Wheat, soft, animal feed	63.0%	19'854	358'951'598	293'037'919	2'288'317
		Laying hens total	88.0%	27'732	531'844'222	706'162'756	10'123'415

Source: Organic Research Centre based on national data sources

Table 84: United Kingdom: Feeding practices and derived calculated amino acid consumption 2011 for broilers and laying hens 2011

Animal Species	Own or Bought	Crop	CP [kg]	LYS [kg]	MET [kg]	CYS [kg]	MET + CYS [kg]
Broilers	Own	Oats	35'099	1'317	559	1'029	1'587
		Peas, field	78'712	5'672	757	1'245	2'002
		Wheat, soft, animal feed	39'861	967	620	938	1'558
	Bought	Soybeans	1'548'309	95'714	21'874	24'195	46'069
		Sunflower cake	1'156'853	43'953	26'298	20'906	47'204
		Wheat, soft, animal feed	2'511'248	60'929	39'076	59'077	98'154
		Broilers total	5'370'083	208'552	89'184	107'390	196'574
Laying hens	Bought	Soybeans	1'410'860	87'217	19'932	22'047	41'979
		Sunflower cake	1'054'156	40'051	23'963	19'051	43'014
		Wheat, soft, animal feed	2'288'317	55'520	35'607	53'833	89'440
		Laying hens total	4'753'332	182'788	79'503	94'930	174'433

Source: Organic Research Centre based on national data sources

8. Protein availability and demand: Summary

8.1 Protein availability and demand in the ICOPP countries

The calculations for the supply-demand balance show a wide spectrum in the ten countries of the ICOPP project and also within Europe. The country-specific calculations show that there are countries like the Netherlands and Switzerland with a very low self-sufficiency in protein feed and, as a consequence, a low self-sufficiency in crude protein, which is necessary to cover the demand of animals in high-productivity livestock farming. On the other hand, there are countries, which produce more feed than they need such as Lithuania. Some countries, like France and Austria, cover about two thirds of their crude protein demand from their own protein feed production.

8.1.1 Livestock numbers per country in a summarized presentation

The table below shows the livestock numbers of the ICOPP countries. The country with the highest number of fattening pigs is Germany with about 31 percent of all fatteners of the ICOPP countries (total more than 800'000), followed by Denmark with 21 percent. The country with the highest number of laying hens (10 million) is France with 29 percent of all laying hens, followed by Germany (28 percent). For dairy cows, the UK is the ICOPP country with the highest numbers (21 percent of all dairy cows), followed by Germany (20 percent).

Table 86 shows the total livestock numbers of the countries in the ICOPP project. The ICOPP countries produce about 808'000 fattening pigs and 19'950'000 broilers per year. They hold about 10'173'000 laying hens and about 666'850 dairy cows.

Table 85: Livestock numbers in the countries represented in the ICOPP project 2011 (summarized presentation)

Country	Animal Species	Category	Livestock Indicator	No.
Austria	Pigs	Breeding sows	Litters [no]	8'000
		Fattening pigs	Animals, slaughtered [no]	62'000
		Gilts	Animals [heads]	1'160
		Weaners	Animals [heads]	65'720
	Poultry	Broilers	Animals, slaughtered [no]	1'550'000
		Laying hens	Animals, places [no]	550'000
		Rearing pullets	Animals [heads]	500'000
	Bovine animals	Dairy cows	Animals [heads]	94'149
		Suckler cows	LSU [no]	68'002
Denmark	Pigs	Breeding sows	Litters [no]	12'842
		Fattening pigs	Animals, slaughtered [no]	171'252
		Gilts	Animals [heads]	3'146
		Weaners	Animals [heads]	90'763
	Poultry	Broilers	Animals, slaughtered [no]	248'055
		Laying hens	Animals, places [no]	550'178
		Rearing pullets	Animals [heads]	428'814
	Bovine animals	Dairy cows	Animals [heads]	63'158
		Suckler cows	LSU [no]	6'679
Finland	Pigs	Breeding sows	Litters [no]	984
		Fattening pigs	Animals, slaughtered [no]	5'280
		Gilts	Animals [heads]	181
		Weaners	Animals [heads]	5'597
	Poultry	Broilers	Animals, slaughtered [no]	301
		Laying hens	Animals, places [no]	112'661
		Rearing pullets	Animals [heads]	90'129
	Bovine animals	Dairy cows	Animals [heads]	5'776
France	Pigs	Breeding sows	Litters [no]	13'924
		Fattening pigs	Animals, slaughtered [no]	81'825
		Gilts	Animals [heads]	2'437
		Weaners	Animals [heads]	86'735
	Poultry	Broilers	Animals, slaughtered [no]	7'692'324
		Laying hens	Animals, places [no]	2'991'557
		Rearing pullets	Animals [heads]	2'393'246
	Bovine animals	Dairy cows	Animals [heads]	79'388
		Suckler cows	LSU [no]	61'054
Germany	Pigs	Breeding sows	Litters [no]	31'600
		Fattening pigs	Animals, slaughtered [no]	256'200
		gilts	Animals [heads]	7'110
		Weaners	Animals [heads]	271'572
	Poultry	Broilers	Animals, slaughtered [no]	2'407'000
		Laying hens	Animals, places [no]	2'900'000
		Rearing pullets	Animals [heads]	2'375'000
	Bovine animals	Dairy cows	Animals [heads]	139'000
		Suckler cows	LSU [no]	101'600

Country	Animal Species	Category	Livestock Indicator	No.
Lithuania	Pigs	Fattening pigs	Animals, slaughtered [no]	344
		Weaners	Animals [heads]	365
	Poultry	Laying hens	Animals, places [no]	3'884
	Bovine animals	Dairy cows	Animals [heads]	8'887
		Suckler cows	LSU [no]	2'687
Netherlands	Pigs	Breeding sows	Litters [no]	8'975
		Fattening pigs	Animals, slaughtered [no]	75'000
		gilts	Animals [heads]	1'539
		Weaners	Animals [heads]	79'500
	Poultry	Broilers	Animals, slaughtered [no]	289'016
		Laying hens	Animals, places [no]	1'236'175
		Rearing pullets	Animals [heads]	1'273'692
	Bovine animals	Dairy cows	Animals [heads]	38'204
		Suckler cows	LSU [no]	8'961
Sweden	Pigs	Breeding sows	Litters [no]	3'428
		Fattening pigs	Animals, slaughtered [no]	27'682
		gilts	Animals [heads]	891
		Weaners	Animals [heads]	29'343
	Poultry	Broilers	Animals, slaughtered [no]	176'030
		Laying hens	Animals, places [no]	746'839
		Rearing pullets	Animals [heads]	597'471
	Bovine animals	Dairy cows	Animals [heads]	44'133
		Suckler cows	LSU [no]	45'183
Switzerland	Pigs	Breeding sows	Litters [no]	3'000
		Fattening pigs	Animals, slaughtered [no]	23'000
		gilts	Animals [heads]	525
		Weaners	Animals [heads]	24'380
	Poultry	Broilers	Animals, slaughtered [no]	486'000
		Laying hens	Animals, places [no]	328'733
		Rearing pullets	Animals [heads]	338'595
	Bovine animals	Dairy cows	Animals [heads]	48'005
		Suckler cows	LSU [no]	16'484
United Kingdom	Pigs	Breeding sows	Litters [no]	11'284
		Fattening pigs	Animals, slaughtered [no]	105'960
		Gilts	Animals [heads]	2'370
		Weaners	Animals [heads]	112'318
	Poultry	Broilers	Animals, slaughtered [no]	7'101'360
		Laying hens	Animals, places [no]	752'831
		Rearing pullets	Animals [heads]	775'351
	Bovine animals	Dairy cows	Animals [heads]	146'137

Source: ICOPP partners based on national data sources and Eurostat

Table 86: Livestock numbers 2011 summarized in total of the ICOPP countries

Animal Species	Category	Livestock Indicator	No.
Pigs	Breeding sows	Litters [no]	94'037
	Fattening pigs	Animals, slaughtered [no]	808'543
	Gilts	Animals [heads]	19'358
	Weaners	Animals [heads]	766'292
Poultry	Broilers	Animals, slaughtered [no]	19'950'086
	Laying hens	Animals, places [no]	10'172'858
	Rearing pullets	Animals [heads]	8'772'297
Bovine animals	Dairy cows	Animals [heads]	666'837
	Suckler cows	LSU [no]	310'650

Source: ICOPP partners based on national data sources and Eurostat

8.1.2 Production and demand of concentrate feed, crude protein, and essential amino acids

Table 87 shows the estimated demand for concentrate feed, crude protein and amino acid per animal species for each ICOPP country. The total demand for concentrate feed is about 1'945'000 metric tons, for crude protein about 310'000 metric tons, lysine about 13'500 metric tons and methionine about 6'200 metric tons.

Table 87: Demand for concentrate feed, crude protein and essential amino acids by animal species 2011

Country	Animal species	Total concentrated feed DM [mt]	Crude protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Austria	Pigs	24'822	4'496	230'530	71'953	142'994
	Poultry	34'004	6'051	275'150	120'050	234'350
	Bovine animals	103'103	13'037	436'565	213'774	516'655
total		161'928	23'584	942'245	405'777	894'000
Denmark	Pigs	52'146	8'523	489'587	160'588	318'661
	Poultry	27'182	4'576	203'374	93'559	176'370
	Bovine animals	115'433	14'598	488'751	239'307	578'393
total		194'761	27'696	1'181'711	493'453	1'073'424
Finland	Pigs	2'338	419	21'379	6'759	13'433
	Poultry	5'336	886	39'154	18'257	34'104
	Bovine animals	13'140	1'907	83'377	31'849	83'169
total		20'815	3'213	143'909	56'865	130'706
France	Pigs	35'248	6'340	323'623	101'969	202'655
	Poultry	188'039	33'508	1'523'883	661'556	1'297'554
	Bovine animals	100'672	17'142	748'490	265'087	613'955
total		323'959	56'990	2'595'997	1'028'611	2'114'164
Germany	Pigs	102'182	18'509	950'532	296'327	588'885
	Poultry	149'418	25'429	1'135'814	516'908	981'219
	Bovine animals	193'473	24'471	819'231	401'136	969'441
total		445'074	68'408	2'905'577	1'214'371	2'539'546
Lithuania	Pigs	106	20	1'036	311	618
	Poultry	163	27	1'169	552	1'029
	Bovine animals	11'250	1'423	47'632	23'323	56'368
total		11'519	1'470	49'838	24'186	58'015
Netherlands	Pigs	29'590	5'367	275'581	85'822	170'553
	Poultry	61'896	10'356	460'992	212'870	399'589

Country	Animal species	Total concentrated feed DM [mt]	Crude protein [mt]	total LYS [kg]	total MET [kg]	total MET + CYS [kg]
Netherlands	Bovine animals	54'974	7'982	304'228	133'946	326'481
total		146'461	23'705	1'040'801	432'638	896'623
Sweden	Pigs	11'081	2'006	103'061	32'136	63'862
	Poultry	36'221	6'057	268'605	124'332	233'387
	Bovine animals	180'174	24'740	976'614	409'647	1'037'898
total		227'476	32'804	1'348'280	566'115	1'335'147
Switzerland	Pigs	9'254	1'675	85'905	26'824	53'308
	Poultry	18'452	3'192	143'859	64'379	123'440
	Bovine animals	33'097	4'186	140'168	68'621	165'864
total		60'803	9'053	369'932	159'824	342'612
United Kingdom	Pigs	36'109	5'994	341'205	112'414	223'524
	Poultry	71'419	13'717	640'843	261'212	534'199
	Bovine animals	222'859	40'042	1'855'355	1'422'790	861'770
total		330'387	59'752	2'837'404	1'796'415	1'619'492
All		1'923'222	306'632	13'415'799	6'178'255	11'003'516

Source: FiBL calculation based on information of the ICOPP partners

The self-sufficiency rate for concentrate feed for each ICOPP country was calculated as the percentage of the actually produced concentrate feed of the total demand of concentrate feed. An overall self-sufficiency rate for concentrate feed of 69 percent is shown in Table 88.

Some countries like the Netherlands (6.2 percent) and Switzerland (14.7 percent) have a low self-sufficiency rate. On the other hand, feed production in Lithuania is four times higher than the actual demand. France and Finland meet their demand. Other countries like Sweden, Germany, Denmark and Austria reach a self-sufficiency rate between 60 and nearly 90 percent.

Table 88: Production and demand of concentrate feed in metric tons dry matter per country 2011

Country	Production concentrate feed DM [mt]	Total demand concentrate feed DM [mt]	self-sufficiency %
Austria	143'127	161'928	88.4%
Denmark	125'899	194'761	64.6%
Finland	26'021	20'815	125.0%
France	334'084	323'959	103.1%
Germany	305'141	445'074	68.6%
Lithuania	49'548	11'519	430.1%
Netherlands	9'142	146'461	6.2%
Sweden	182'610	227'476	80.3%
Switzerland	8'959	60'803	14.7%
United Kingdom	140'502	330'428	42.5%
Total	1'325'033	1'923'222	68.9%

Source: FiBL calculation based on information of the ICOPP partners

The self-sufficiency rate for crude protein for each ICOPP country was calculated as the percentage of the actually produced crude protein of the total demand of crude protein. An overall self-sufficiency rate for crude protein of 56 percent is shown in Table 89.

Table 89: Crude protein production and demand and degree of self-sufficiency in the ICOPP countries 2011

Country	Crude protein production [mt]	Crude protein demand [mt]	self-sufficiency %
Austria	17'587	23'584	74.6%
Denmark	13'777	27'696	49.7%
Finland	3'503	3'213	109.0%
France	42'338	56'990	74.3%
Germany	43'647	68'408	63.8%
Lithuania	7'696	1'470	523.7%
Netherlands	1'002	23'705	4.2%
Sweden	23'180	32'804	70.7%
Switzerland	1'002	9'053	11.1%
United Kingdom	-17'982	59'711	30.1%
Total	172'051	306'632	56.0%

Source: FiBL calculation based on information of the ICOPP partners

For all countries, it should be noted that the self-sufficiency rate for concentrate feed and crude protein looks higher than it actually is because the composition of the crops grown is not balanced. This becomes particularly noticeable in the cases of Finland and France. In the case of France, Table 89 shows that in spite of a high self-sufficiency rate for concentrate feed (103 percent), the demand for crude protein (74 percent) is not met. For Finland, the self-sufficiency rate for concentrate feed (DM) of 125 percent shows a distorted picture. Around 46 percent of the total Finnish feed production of 26'000 metric tons (DM) consists of oats. For a balanced animal diet, this means that in reality, protein feed like soybeans but also other energy crops like wheat have to be imported from other countries.

It is obvious that, except for Lithuania, organic crude protein demand clearly exceeds availability, and an overall gap of approximately 138'000 metric tons of crude protein exists within the ICOPP countries.

According to the data in Figure 69, it seems quite unrealistic that the ICOPP countries will be able to supply the organic protein demand with their own efforts and increase production in the foreseeable future. However, some countries might benefit from the situation of the protein gap, e.g. Lithuania produces more than it actually needs itself and hence could become an exporter.

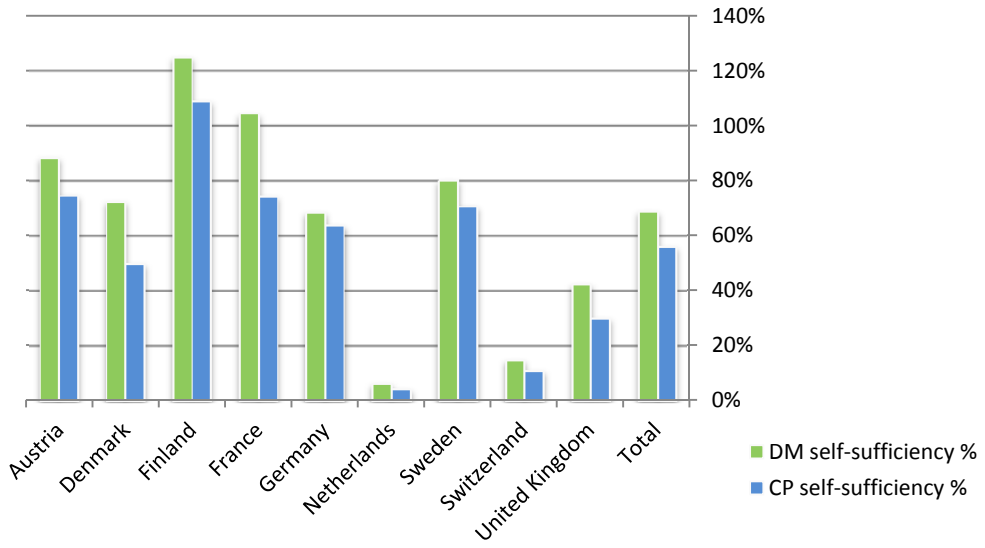


Figure 69: ICOPP countries: Self-sufficiency rate for animal feed 2011 (Dry matter of concentrate feed and crude protein)
Source: FiBL calculation based on information of the ICOPP partners

Table 90: Amino acid production, demand and self-sufficiency rate in the ICOPP countries 2011

Country	total LYS production [kg]	total LYS demand[kg]	Self-sufficiency rate	total MET production [kg]	total MET demand [kg]	Self-sufficiency rate	total MET + CYS production [kg]	total MET + CYS demand [kg]	Self-sufficiency rate
Austria	712'234	942'245	75.6%	273'745	405'777	67.5%	654'453	894'000	73.2%
Denmark	479'219	1'181'711	40.6%	213'987	493'453	43.4%	536'269	1'073'424	50.0%
Finland	160'676	143'909	111.7%	48'367	56'865	85.1%	126'065	130'706	96.4%
France	1'780'672	2'595'997	68.6%	645'154	1'028'611	62.7%	1'525'971	2'114'164	72.2%
Germany	1'807'657	2'905'577	62.2%	565'442	1'214'371	46.6%	1'449'118	2'539'546	57.1%
Lithuania	387'497	49'838	777.5%	94'854	24'186	392.2%	241'879	58'015	416.9%
Netherlands	32'672	1'040'801	3.1%	15'822	432’638	3.7%	39'450	896’623	4.4%
Sweden	961'262	1'348'280	71.3%	322'085	566'115	56.9%	827'455	1'335'147	62.0%
Switzerland	37'050	369'932	10.0%	15'655	159'824	9.8%	38'417	342'612	11.2%
United Kingdom	716'161	2'837'510	25.2%	252'559	1'796'415	14.1%	638'286	1'619'281	39.4%
Total	7'075'100	13'415'799	52.7%	2'447'668	6'178'255	39.6%	6'077'362	11'003'516	55.2%

Source: FiBL calculation

Based on the calculations of the concentrate feed production and its crude protein and essential amino acid content, and the estimation of the demand of the animal categories, the self-sufficiency for the amino acids methionine, lysine and cysteine was calculated (Table 90).

From this calculation, it is obvious that the supply with amino acids is lower than the supply with crude protein. The total self-sufficiency of the ICOPP countries is just above 50 percent for lysine, about 40 percent for methionine and about 55 percent for methionine and cysteine. In the Netherlands and Switzerland the supply is just above or even below 10 percent (Figure 70). These data show that the protein feed crops grown in the ICOPP countries cannot supply the livestock requirements for essential amino acids.

For example, Finland with a self-sufficiency of 109 percent of crude protein, reaches only 85 percent of self-sufficiency for methionine. In the case of the UK, the comparison shows 30 percent self-sufficiency for crude protein as opposed to a self-sufficiency of only 14 percent for methionine.

In order to meet the amino acid requirements for the individual animal categories, the types of protein crops, which could be produced in a country, are relevant. For instance, soybeans, with their good amino acid balance, are mainly produced in Southern European countries. Growing them in Germany or Switzerland is still a challenge; in Northern European countries it is nearly impossible at the moment.

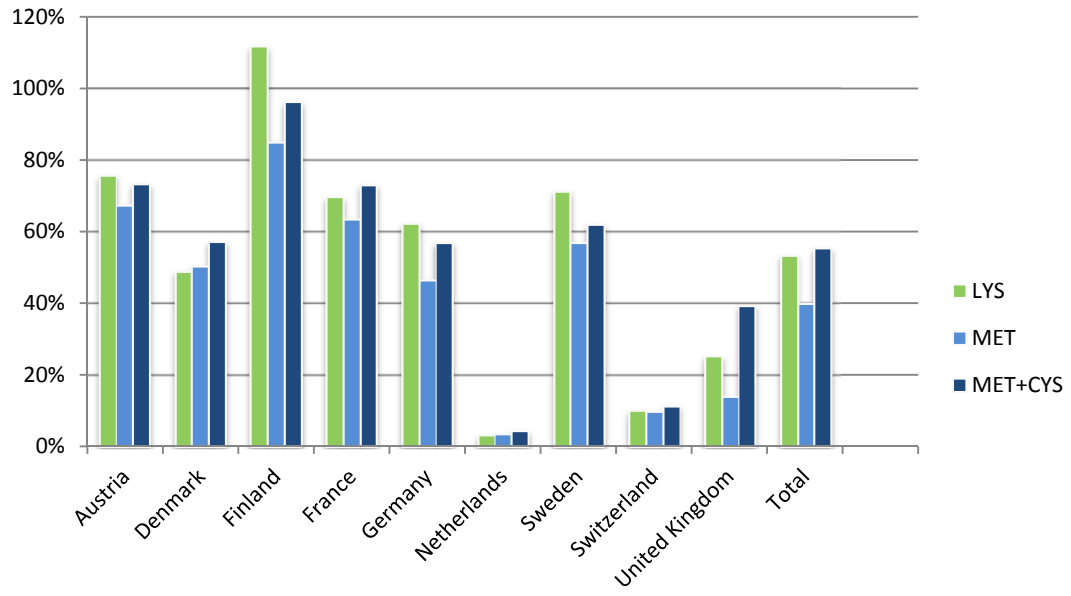


Figure 70: Self-sufficiency rate with amino acids 2011 in the ICOPP countries

Source: FiBL calculation based on information of the ICOPP partners

8.1.3 Proportion of concentrate feed and crude protein demand by animal species

Over 53 percent of the total demand (1’923’000 t) for concentrate feed is fed to bovine animals, 16 percent was fed to pigs and 31 percent to poultry (Figure 71).

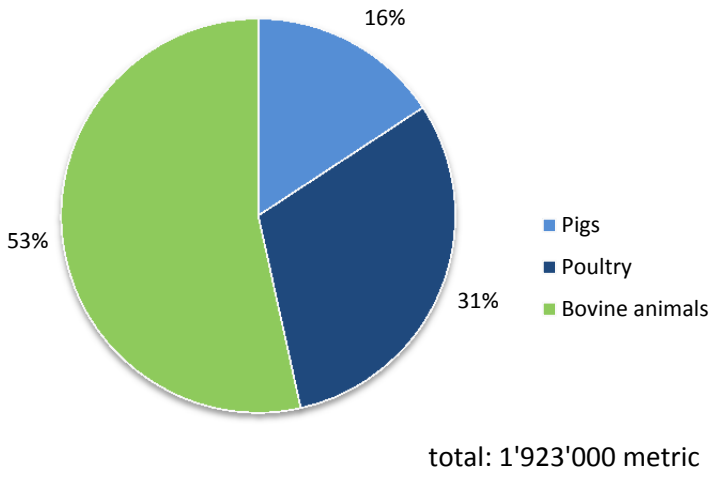


Figure 71: ICOPP countries total: Demand (%) for concentrate feed (DM) of the different animal species 2011

Source: FiBL calculation based national sources

The demand for crude protein was more than 300’000 metric tons. Seventeen percent was fed to pigs, 34 percent to poultry, and 49 percent to bovine animals (Figure 72).

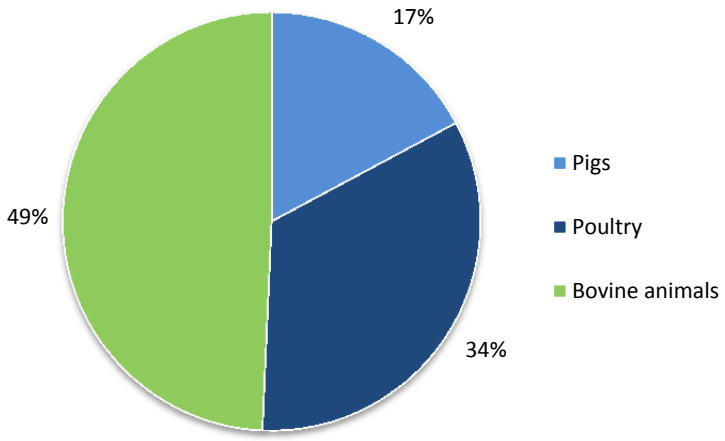


Figure 72: ICOPP countries total: Demand (%) for crude protein by livestock species 2011

Source: FiBL calculations based on data provided by national sources.

8.2 Protein availability and demand in Europe - including countries that are not in the ICOPP project

While the data as calculated in the ICOPP project seem to be very close to reality, because of the detailed collection of the data in ICOPP countries, the extrapolation to Europe is a rough estimation because of the lack of reliable data. There are only few data on feed production in the countries, and there are no data on feed imports and exports.

With the calculation of the availability of and demand for protein feed it, is obvious that there is a heterogeneous development of the organic sector in the European countries. Some "export countries" have shown a large increase in cultivated organic area, like Lithuania (more than 1000 percent increase from 2002 to 2012) or Romania (+500 percent), with a still small domestic organic market (Willer et al. 2014b). The sector development focuses on crops and not on livestock production. The focus on crop production can perhaps partly be attributed to the increasing demand for organic products for human consumption and organic feed in the Western European countries.

Table 91 shows some European countries with a high proportion of organically cultivated area for feed components and less animal production. These countries are possibly able to cover, at least partially, the demand for feedstuff from the countries, which cannot fulfil their own demand (hereinafter called "import countries").

Table 91: Organic shares of cereals, dried pulses, oilseeds, bovine animals, pigs and poultry in Hungary, Lithuania and Romania 2012

Country	Area/livestock	Crop/livestock category	Share (%)
Hungary	Agricultural land	Cereals	1.0%
		Dried pulses and protein crops for the production of grain	12.5%
		Oilseeds	1.0%
	Livestock	Bovine animals	2.9%
		Pigs	0.1%
		Poultry	0.3%
Lithuania	Agricultural land	Cereals	6.3%
		Dried pulses and protein crops for the production of grain	61.0%
		Oilseeds	2.1%
	Livestock	Bovine animals	3.6%
		Pigs	0.1%
		Poultry	0.0%
Romania	Agricultural land	Cereals	2.0%
		Dried pulses and protein crops for the production of grain	5.2%
		Oilseeds	3.0%
	Livestock	Bovine animals	0.4%
		Pigs	0.0%
		Poultry	0.0%

Source: FiBL based on national data sources, Eurostat and FAOSTAT

The ICOPP countries are highly important for the European organic market for animal products: They manage 50 percent of the European organically cultivated area, but hold 85 percent of organically produced pigs, 80 percent of organically produced poultry and 70 percent of organically produced cows.

Table 92 shows the total European feed and crude protein demand. The sum is the result of the demand for concentrate feed in Europe calculated using the Eurostat Data: the number of animals was transformed into livestock units. The livestock units were multiplied by the concentrate feed (DM) and the crude protein demand (Table 16).

Table 92: Total European concentrate feed and crude protein demand 2011

	Concentrate feed in dry matter [mt]	Crude protein[mt]
Total organic feed demand Europe	2'350'000	390'000

Source: FiBL calculation

Based on the categorization of the countries in Table 15 into import and export countries the European import demand of feed is estimated as 780'000 metric tons (DM) and 132'000 metric tons crude protein (Table 93).

Table 93: Total import demand of the European countries 2011

	Concentrate feed in dry matter [mt]	Crude protein [mt]
Import demand of the countries with import needs	780'000	132'000

Source: FiBL calculation

To combine the import demand of European countries with the possible production in Europe, the FiBL experts assumed an export volume of feed components of about 20 percent of the total crop production (Table 94) of about 660'000 metric tons (DM). This nearly matches the demand of the import countries of about 780'000 metric tons (DM). There is, however, a bigger gap between the demand for crude protein (132'000 mt) and the crude protein production of 92'000 metric tons. This calculation includes all kind of crops, not just protein crops.

Table 94: Crop production in the European feed export countries 2011

	DM [mt] Production	CP [mt] Production
Total production of human food and animal feed of the feed export countries	3'300'000	462'000
Assumed export for feed 20 %	660'000	92'000

Source: FiBL calculation

The demand of the import countries is focused on protein crops, because of the necessary essential amino acid balance. Therefore, a focused calculation on protein crops is necessary. To explore the possible supply-demand balance, different scenarios were calculated (Table 95). Based on the data from Eurostat and national data sources (2011) the production of pro-

tein crops in the export countries was about 460'000 metric tons (DM) with a calculated crude protein production of approximately 118'800 metric tons.

Table 95: Protein crop production in the European feed export countries and scenarios of possible feed export compared to the import demand in Europe

	DM [mt] Production	% of the import demand	CP [mt]Production	% of the import demand
Production of protein crops in the exporting countries	460'000		118'800	
Scenario 1: Export protein crops 20 % for feed	92'000	11.8%	23'760	18%
Scenario 2: Export protein crops 60 % for feed	276'000	35.4%	71'280	54 %
Scenario 3: Export protein crops of 80 % for feed	416'000	53.3%	95'040	72 %

Source: FiBL calculation

The extrapolation (scenario 3) shows that there is still a gap of an estimated 50 percent of protein crops and 30 percent of crude protein, even if the export countries export 80 percent of their produced protein crops (including soya and other oilseeds) to the import countries in Europe.

9. Conclusions and outlook

The calculations for the supply-demand-balance show a wide spectrum in the 10 countries of the ICOPP project and also within Europe. The country-specific calculations show that there are countries like the Netherlands and Switzerland with a very low self-sufficiency in protein feed, and, as a consequence, a low self-sufficiency in crude protein, which is necessary to fulfil the demand of animals in high-productivity livestock farming. On the other hand, there are countries, which produce more feed than they need, such as Lithuania. Some countries such as France and Austria reach about two-thirds of their crude protein demand with their own protein-feed production.

All of the ICOPP countries together had a self-sufficiency rate for about 69 percent of concentrate feed and about 56 percent crude protein in 2011. Supply of concentrate feed (DM) was 1.33 million metric tons; demand for concentrate feed (DM) was 1.92 million metric tons. The demand for crude protein was more than 300'000 metric tons, whereas production was only 170'000 metric tons. It seems quite unrealistic that the ICOPP countries will be able to supply the organic protein demand with their own efforts and increase production in the near future. However, some countries might benefit from the situation of the protein gap (e.g. Lithuania that produces more than it actually needs).

This picture is, however, not representative for the European production. While the data as calculated in the ICOPP project seem to be very close to reality, because of the detailed collection of the data for the ICOPP countries, the extrapolation to Europe is a rough estimation because of the lack of reliable data. The extrapolation shows that there is still a gap of an estimated 30 percent for crude protein in Europe, even if the countries, whose production of feed exceeds their own requirements from livestock, will export 80 percent of their produced protein crops (including soya and other oilseeds) to the countries with feed imports in Europe.

Regarding the supply with essential amino acids, it became obvious that it is lower than the supply with crude protein. The total self-sufficiency of the ICOPP countries is just above 50 percent for lysine, about 40 percent for methionine and about 55 percent for methionine and cysteine. In order to meet the amino acid requirements for the individual animal categories, the types of protein crops which could be produced in a country are relevant. For instance soybeans, with their good amino acid balance, are mainly produced in Southern European countries, growing them in Germany or Switzerland is still a challenge; in Northern European countries it is nearly impossible at the moment.

The European Commission is envisaging a stronger regulation for feed - with a higher proportion of feed produced on-farm/in the region. It is currently under discussion that this proportion should be about 90 percent for ruminants and 60 percent for non-ruminants. However, the results of our calculations show that this might be difficult to achieve for some countries.

One outcome of the calculations carried out among the partners of the ICOPP project is the finding that a large amount of concentrate feed is fed to ruminants: 53 percent of the concentrate feed and 49 percent of the crude protein is fed to ruminants. If a part of the concentrate feed for ruminants (1'030'000 metric tons) would be used for feeding non-ruminant animals, a great step forward could be made.

Moreover other solutions must be found. There are different feeding possibilities (e.g. roughage feeding, algae, insect protein), which were explored in the ICOPP project and other research projects, but there is still a need for more innovative solutions.

Considering that there is a substantial protein gap in organic farming, imports remains an important option when it comes to closing this gap. The focus should be on the sustainable development of organic farming with fair-trade standards and ecologically acceptable transportation of the imported products. Therefore, the aim should be to develop organic farming all over the world, including the development of organic markets for the local population and not to primarily export in order to feed the animals in other countries. Nevertheless, for some countries exports are, and can be, the first step to organic farming.

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Due to the request for using entirely organically produced feed for livestock by 31st December 2017, there is a need to explore and evaluate the practical possibilities in doing that from a production and animal welfare point of view. Thus, the CORE Organic II project ICOPP was initiated to suggest economical viable feeding strategies based on 100% organic feed across Europe, which will supply poultry and pigs the required level of nutrients in different phases of production and support high animal health and welfare. In order to evaluate the availability of feeds across Europe, existing literature and relevant statistical data on organic feed is compiled in this book. Information sources for protein contents of key crops as well as existing data on protein demand of pigs and poultry for the feeding calculations were investigated. Based on these data the balance between feed supply and feed demand was calculated in terms of dry matter, energy, crude protein and essential amino acids.

ICOPP is the acronym of the project "Improved Contribution of local feed to support 100% Organic feed supply to Pigs and Poultry" which ran from 2011 to 2014. It was funded through the European CORE Organic II ERA-net programme to support organic research, and led by Aarhus University in Denmark with 13 partners across 10 EU countries.

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