Overview of supply and demand for concentrated organic feed in the EU in 2002 and 2003 with a particular focus on protein sources for mono-gastric animals

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Introduction

Task 4.2 of the project Organic Revision is to investigate the availability of limiting amino acids for pigs and poultry in the EU and different member states and candidate countries and to assess the different strategies used to compensate for restricted nutrient supply. The aim of this report is to present an overview of supply and demand in the EU, summarising the situation of supply and demand in 2002 and 2003. A short overview of the situation was presented at the Project Workshop at BIOFACH 2005. A similar preliminary report on the possibilities of feeding monogastrics on 100% organic diets has been prepared by Sundrum *et al*. (2005). For further information about this and other reports in the project see www.organic-revision.org.

A further aim of this preliminary report is to set out the data sources, assumptions and procedures that were used to assess the availability of protein sources for 100% organic diets for pigs and poultry. We hope to contribute to the continuing debate on how to meet the challenge of 100% organic diets for all organic livestock in the EU in the near future.

The following section includes some background material on the current situation both at EU level and in some member states, followed by an overview of the data sources and estimates and an explanation of the methodology and assumed rations used in the calculations. The results section presents estimates of organic stock numbers in the EU in key categories of all animals (including non-monogastric categories) and of organic production of concentrated feed-stuffs, which are broken down into cereals and protein sources. This is followed by balancing calculations and finally some tentative conclusions.

The situation at the moment

EU level

Annex I B 4 of the Regulation (EEC) 2092/91 specifies that organic livestock should be fed on organic diets, but allows for some derogations, for example that up to 30% of the diet can come from in-conversion holdings. Article 4.8, in particular, permitted the limited used of conventional feed (10% for herbivores, 20% for non-herbivore species) during a transitional period that expired in August 2005, i.e. five years after the regulation had to be implemented in all member states.

A review of the Annex II part C (Feeding stuffs) was carried out in 2003 with the aim of deleting from the Annex those conventional feed materials that were no longer needed. In Regulation (EEC) 2277/2003, these reviews were incorporated into the main regulation alongside other changes (e.g. 50% of feeds should be home-grown for herbivores). The following preamble to the regulation (EEC) 2277/2003 illustrates the difficulty that member states anticipated in following the timetable laid down in the EU 1804/1999 (livestock regulation):

> *"Most of the conventional feed materials and in particular protein crops are still indispensable, at least in some Member States. Moreover, conventional milk by-products are still necessary in organic farming and*

further minerals are required to ensure the welfare of organically-reared livestock."

On the other hand, the emphasis in the EU Organic Action Plan is on a call to maintain integrity in organic agriculture, in particular by maintaining the end-dates of the transitional periods laid down, including those for the non-organic feed allowances.

After negotiation of several months, a compromise in relation to the feeding of conventional feed has been agreed. Where farmers can show, to the satisfaction of the inspection body or authority of the Member State, that they are unable to obtain feed exclusively from organic production, the following percentages and time limits then apply.

- For herbivores, a maximum percentage of conventional feedstuffs has been set at 5% of annual dry matter intake for a transitional period ending in December 2007
- For other species, a stepwise reduction over a longer period has been agreed:
    - 15% of annual dry matter from conventional sources until 31 December 2007
    - 10% from 1st January 2008 until 31 December 2009
    - 5% from 1st January 2010 until 31 December 2011

In the daily intake, 25% conventional dry matter intake should not be exceeded. It is now up to the farmer to demonstrate that organic feed is not available and for the certification bodies and national authorities to judge that this is a true claim. For this purpose, it is important to provide information of supply and demand, which is the aim of this report.

Sector strategies to meet the challenge

Strategies to cope with the pending changes vary between the types of animal (herbivores or monogastrics), certification bodies and countries.

Herbivores

Some countries and/or certification bodies have introduced 100% diets for organic ruminants ahead of the previous schedule in the EU regulation. In Denmark, the organic cattle industry has adopted 100% organic feed as the voluntary code of practice. In Germany, two producer organisations (BIOLAND and DEMETER) have introduced 100% organic diets for ruminants in their standards. Others have reduced the number of permitted conventional components further than the EU Regulation (for example Naturland, BIOSUISSE).

However, there is some indication that the requirements for higher organic percentages may lead to increases in the use of imported protein from developing countries (e.g. Soya from Brazil) to replace the non-organic waste products from the food industry that were formerly used as protein sources (e.g. potato protein).

Monogastric animals

In France, it is already prohibited to use more than 10% of conventional products in organic animal feed for pigs and poultry.

To my knowledge, no certification body has yet introduced the requirement for 100% organic diets ahead of schedule, but some feeding experts and consultants have provided examples for 100% organic diets. In Denmark, Germany and the UK, a limited number of trials looking into the impact of 100% organic diets on animal health and production performance are currently underway.

Based on review of this and other available literature, Sundrum *et al*. (2005) concluded that it is clearly possible to formulate 100% organic diets without the use of non-organic feedstuffs, although it is more difficult to accurately meet the requirements of the animals in organic than in conventional systems. It is important to consider the main objectives of organic animal production as a land-based system, avoiding the use of external inputs and giving priority to high quality rather than maximum production. Due to the restricted availability of limiting amino acids in organic poultry and pig production, protein accretion capacity is lower compared to conventional production. To adapt to this situation, the feeding of organic pigs and poultry should be more closely adapted to their growth stages. However, the preferred use of home-grown feedstuffs and the restricted choice of bought-in feedstuffs can be the cause of considerable variation in the composition of the diets, and this increases the need for analysis of the ingredients in the calculation of rations. For more detailed recommendations in relation to formulating diets, see the preliminary report by Sundrum *et al*. (2005).

Data sources and methodology

The supply and demand of organic concentrate feeds (both cereals and protein sources) were calculated using statistical data from a number of other EU-funded research projects including EU-CEE-OFP (QLK5-2002-00917, http://www.irs.aber.ac.uk/EUCEEOFP/), OMIARD (QLK5-2000-01124; http://www.irs.aber.ac.uk/OMIaRD/) and published data, supplemented by the opinion of a number of experts on feeding organic livestock.

Data sources for numbers of organic animals

A complete set of data on the number of organic livestock in the EU has not been published so far. The most complete data set for broad categories of organic livestock exists for 2002 in two reports in the EU-CEE-OFP project: Olmos and Lampkin (2005) and Praznan *et al*., (2004). In the case of Olmos and Lampkin (2005), unpublished data were made available for this overview. The report from Olmos and Lampkin (2005) provides data for members of EU 15 and Switzerland and Norway for 2002 and 2003, but livestock data are missing for the UK and Spain. For the UK, Soil Association (SA, various years) and DEFRA (2004) data were used after crosschecking with industry experts. For Spain, Garcia (2005) provided livestock data for 2004, on which 2002 and 2003 data could be estimated.

Praznan *et al*. (2004) provide data for 2002 for the new member states, apart from Poland, Malta and Cyprus. An existing but unpublished draft of 2003 data for most

new member states countries has been used to calculate an estimate for the total EU figures for 2003. The missing countries were not considered in the calculation.

The calculation of the feed balance in the EU 25 was carried out for two years, 2002 and 2003, using data estimates for 2003 where no other data were available. Based on more detailed data from some countries and expert assessment, the broad categories of livestock were broken into the following sub-categories, for which demand figures for concentrate feeds exist in the literature.

Bovine: dairy cows, suckler cows, other cattle
Sheep: ewes with lamb
Pigs: sows and finishing pigs
Chicken: layers and table chickens.

No other category of poultry was considered.

Assumed annual feed requirements for animal categories

Annual feed requirements were based on standard demand figures used for farm and ration planning and on expert advice from Austria, Germany, Denmark and the UK (see Table 1).

Table 1: Standard assumptions for the annual concentrated feed intake, including percentages of cereals, EU pulses and other protein sources

Animal category	Total concentrate requirements per head and year	Cereals	Pulses (EU grown)	High quality protein sources
Bovine	*t/hd/a*			
Dairy	1.00	65%	35%	0%
Suckler	0.20	85%	15%	0%
Other	0.15	85%	15%	0%
Sheep	*t/hd/a*			
Ewes with lambs	0.02	85%	15%	0%
Pigs	*t/hd/a*			
Sows	1.5	71%	22%	7%
Fattening pigs	0.30	65%	15%	20%
Chicken	*t/1000 head/a*			
Layers	45.00	50%	25%	25%
Table birds	6.0	55%	25%	20%

Sources: Lampkin *et al.*, (2004) and expert survey

Where national demand figures have varied considerably, the estimates consider the distribution of animals, giving a higher weighting to expert recommendations from those countries where a high proportion of the organic animals are kept.

For example, the assumed average concentrate feed for dairy cows varied between countries from 0.8 to 1.2 t/head per year between countries, but the majority of animals are kept in countries with higher concentrate intake. However, some individual producers probably feed higher or lower amounts. For instance, in mountain regions where no cereals are grown, lower concentrate feeding is common. It is also the stated aim of many organic milk producers to reduce the use of concentrate feed for their cows in line with the principles of using farm-derived

resources. However, in the final estimate, we tried to use a value that is likely to represent average use across the EU rather than the best practice of individuals.

In a second step, the total annual feed requirements for each sub-category were broken down into cereals and protein, the latter divided between home-grown pulses (that could be grown in most parts of the EU such as beans, peas and lupins) and other high quality protein sources that would come from both plant (e.g. soya) and animal sources (e.g. fishmeal).

For ruminants, the experts' opinion on the total protein content requirements of the concentrate varied considerably, ranging from 5% to 40%. This may be due to variations in the use of clover or clover-grass silage in dairy rations, which would influence the need for protein supplements. It is assumed that all concentrated protein for ruminant diets can be grown in the EU, as protein quality is not considered a limiting factor in organic cattle and sheep production. For pigs and poultry, the protein requirements were determined on the basis of current standard organic rations.

Table 2: Modified rations to meet 100% organic diets: Assumption for annual concentrated feed intake and percentages of cereals, EU pulses and high quality protein sources

Animal category	Total concentrate requirements per head and year	% Cereal	% Pulses (EU grown)	% high quality protein sources
		(percentage in brackets indicates change to assumption in Table 1)		
Bovine	*t/hd/a*			
Dairy	0.60 (-0.4)	50% *(-15%)*	50% *(+15%)*	0%
Suckler	Unchanged			
Other	Unchanged			
Sheep	*t/hd/a*			
Ewes with lambs	Unchanged			
Pigs	*t/hd/a*			
Sows	1.0 (-0.5)	65% *(-6%)*	30% *(+8%)*	5% *(-2%)*
Fattening pigs	0.30	64%*(-1%)*	29% (+14%)	7% (-13%)
Chicken	*t/1000 head/a*			
Layers	45.0	53% (+3%)	38% (+13%)	9% (-16%)
Table birds	6.0	63% (+8%)	15% (-10%)	22% (+2%)

Source: Sundrum *et al.* (2005) and personal communication

Separate calculations were carried out to gauge the potential impacts across the EU of results from ongoing research and on-farm experiments, which try to meet the challenge of 100% organic feed requirements through considerable modifications of the rations for pigs and poultry, and to assess the potential effects of reduced concentrate feeding for dairy cows. The assumptions for these modified rations (see Table 2) are based on published ration examples for 100% organic, which Sundrum *et al.* (2005) reviewed in detail in the other preliminary report related to 100% organic diets in this project. For organic laying hens they considered rations with a reduced energy content in the diet that can be used to stimulate a higher feed intake and thus higher intake of limiting amino acids. For pigs, the issues of adapting the

supply of amino acids to the growth stages and increasing the proportion of roughage in the diet are considered. Under the heading of modified rations, variation in the protein content of ruminant diets based was also considered, because of the indirect effect this could have on availability of protein sources for pigs and poultry. The table also highlights the change compared with the standard assumptions in Table 1.

Data sources for organic feed availability

Organic feed availability was calculated using data from two reports on land-use for 2002 and 2003 in the EU-CEE-OFP project (Olmos and Lampkin, 2005 and Praznan *et al.*, 2004). Land-use data, broken down into categories of arable, grassland and permanent crops (with some uncertainty whether short term clover in arable rotations is included as arable or grassland), were available for most countries for 2002 and 2003, alongside the areas of cereal crops. However, not all countries report on protein crops, and further uncertainty arises because livestock producers may grow pulses for use on-farm, which are not sold on the market and not included in the national statistics. Furthermore, for ruminants, where cereals or pulses are grown for whole crop silages, the distinction between forage and concentrate feeds can be problematic in some cases. It is very difficult to obtain EU-wide data on the availability of other protein sources permitted in organic systems (for example, fish meal believed to be widely used in Northern countries).

No attempts have been made to consider feed from conventional sources currently used in organic rations nor to estimate the imports of organic feed into the EU, as no relevant statistical data have been identified.

Results

Numbers of organic animals

Table 3 shows the numbers of organic animals in the EU in 2002 and 2003, and Figure 1 and Figure 2 illustrate the breakdowns among the member states. The most important countries keeping bovine organic livestock are Austria, Germany, Italy and Denmark. The most important sheep producers are Italy, UK, Germany, France and Greece. Most pigs are kept in Germany, Denmark, France and UK, and the most important countries producing organic poultry are France and the UK.

Table 3: Numbers of organic animals in the EU 25 in 2002 and 2003

Animal category	2002	2003
Bovine	1.39 million	1.47 million
Sheep	1.71 million	1.64 million
Pigs	552,000	473,000
Chicken (layers and broilers)*	16.1 million	17.3 million

*Other categories of poultry were ignored because of the very limited amount of data available.
Source: Own data

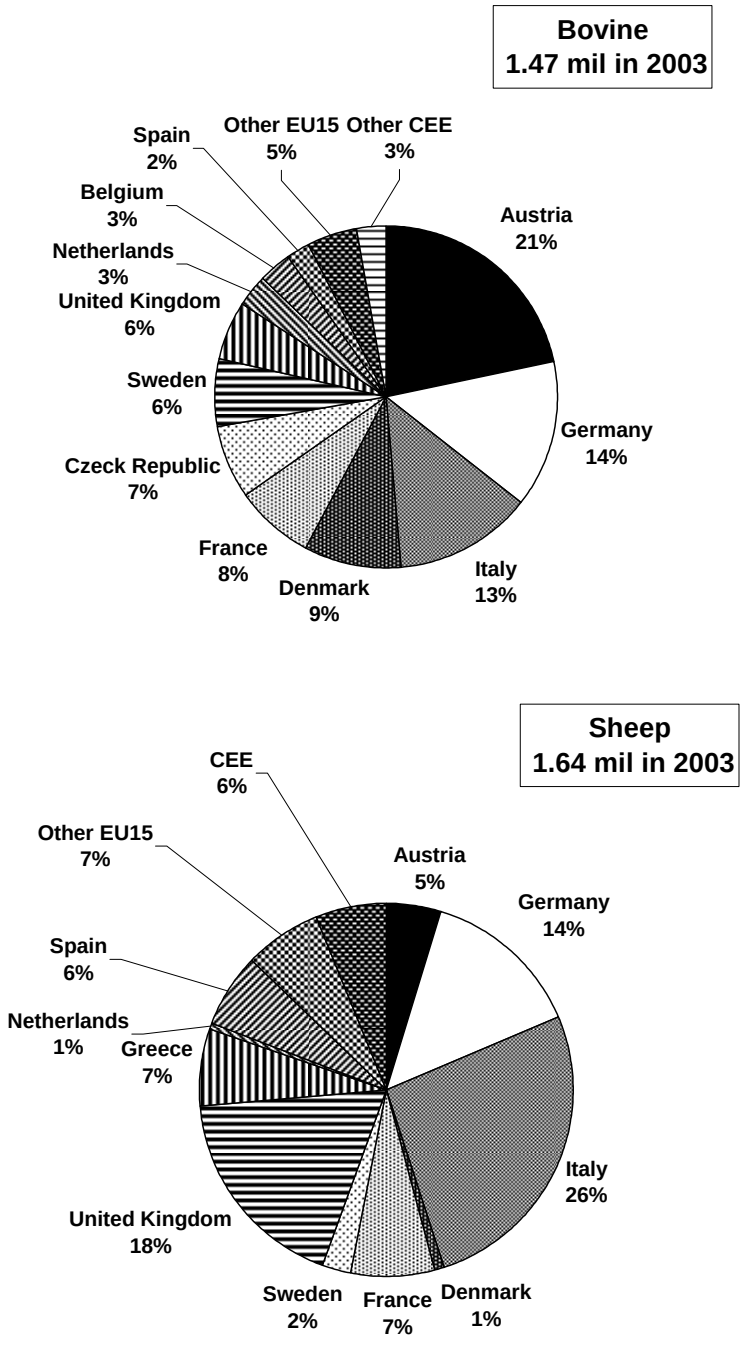


Figure 1: Breakdown of organic herbivores in the EU member states in 2003

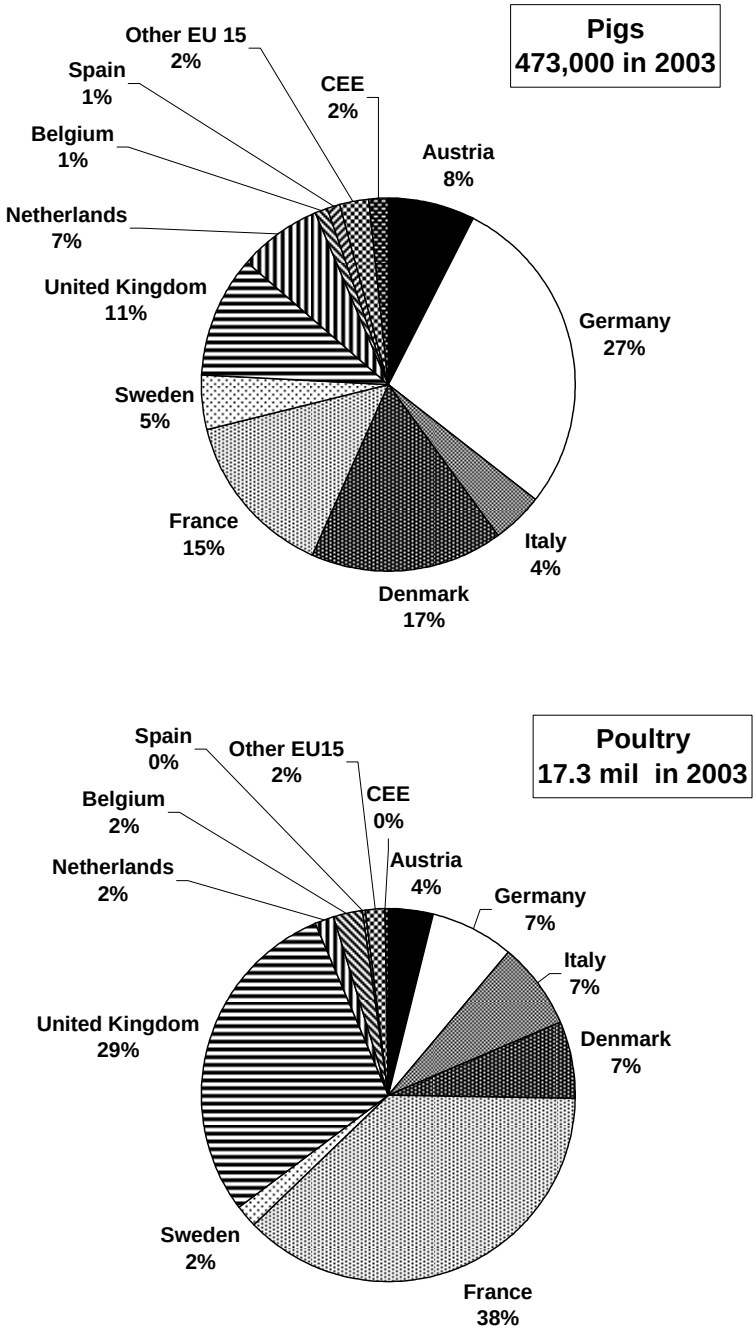


Figure 2: Breakdown of organic mono-gastric animals in the EU member states in 2003

In general terms, it appears that livestock numbers increased between 2002 and 2003 in the new member states. However, this has limited impact on the overall balance because the total livestock numbers in the new member states are less than 10% of the overall total in most categories. Among EU15 members, increases in the number of cattle occurred in Greece and Portugal, whereas numbers appear to have declined in Denmark. Sheep numbers declined considerably in Italy and the Netherlands, but increased in Portugal and Greece. Numbers of pigs declined between 2002 and 2003 in most of the main pig production countries. The numbers or organic chicken appear to have increased in most old member states, with the exception of the Netherlands and Denmark.

Production of organic feedstuffs

Land-use shows considerable variation between the EU member states. The western and mountainous regions have a very high proportion of area in organic grassland. Table 4 shows land areas of organic cereals and pulses in 2002 and 2003, as well as the assumed production in tonnes, which was calculated using an average yield estimate of 3 t/ha. Figure 3 illustrates the main producing countries in the breakdown of areas in the EU member states.

Because of the limited data availability, there is considerable uncertainty in these estimates, so the sensitivity of the calculation to variation in yields was tested below. Based on Hamm and Gronefeld's (2004) data for the organic market in 2001, it is assumed that 55% of the total cereal production is for feed, and the rest is for seed and human consumption.

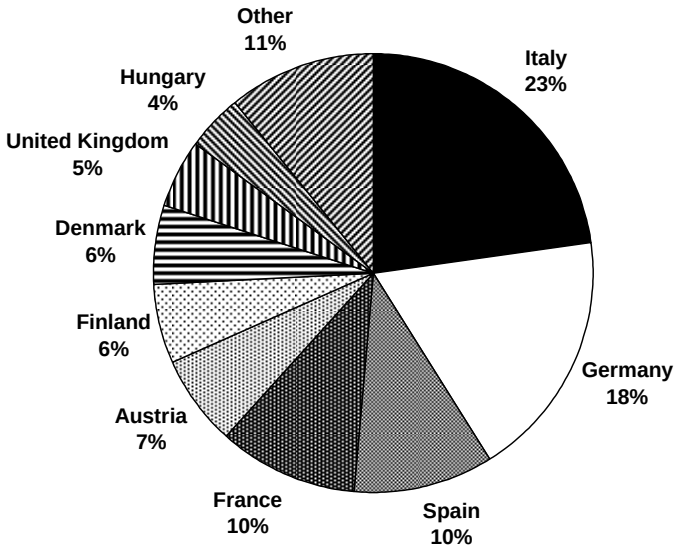


Figure 3: Breakdown of land area for organic cereals and pulses in 2003

It was further assumed that the majority of organic pulses grown (90%) are used for animal feed, the rest for seed and human consumption.

It appears that the total area for pulses in the EU declined in 2003 due to a decline in Italy, but several countries do not report on area for pulses. However, given the reduced reliance in on conventional sources in future, it could be expected that the area of organic protein crops may increase again in future. The decision of individual producers to grow organic pulses is, however, not only influenced by knowledge about future changes in the regulation, but also by the prices that are offered.

The breakdown of the organic land area for cereals and pulses shows that five countries currently supply nearly half of the concentrate feed that is grown in Europe. Germany, Austria, Italy and France are all also among the most important producers of some categories of organic livestock.

Table 4: Production of organic cereals and pulses in the EU 25 in 2002 and 2003

Land use	2002 (ha)	2003 (ha)	2002 (t)	2003 (t)	Major producing countries
Cereals	881,700 ha	932,700	2.65 million	2.79 million	Italy, Germany, Spain and France
Pulses	109,500	88,300	328,000	265,000	Italy, Germany, France and Austria

Source: Own data

Calculated balances for concentrate feed, cereals and protein sources

In 2002 and 2003, the EU 25 grew approximately 3 million tonnes of organic cereals and pulses, 1.75 million of which are likely to have been used as concentrated animal feed. This total supply of concentrated feed grown in the EU (see Table 5) was calculated using land-use data, average yields and an assumed percentage of the supply used for feed. Of this, over 80% would have been cereals, and between 13% and 17% would have been pulses.

The total demand, calculated by multiplying livestock numbers with assumed rations, was approximately 1.1 million tonnes both in 2002 and 2003, and thus was lower than the likely total supply.

This total demand for concentrate feed would have been distributed between the different categories of animals as follows:

- 55 to 60% to ruminants
- over 25% to poultry
- 15 to 18% to organic pigs

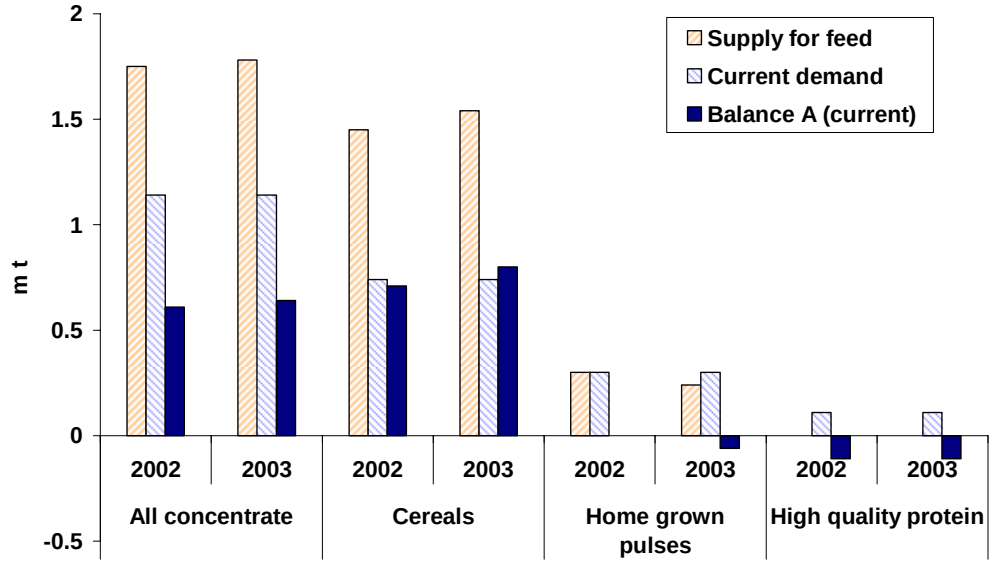
For home-grown pulses, an even higher percentage is required for ruminants (64%), approx. 25% for poultry and 10% for pigs. Changes in the numbers of ruminant livestock or in their rations could influence organic feed availability for pigs and poultry across the EU because of their high share in the calculated demand.

The breakdown of the supply and demand data into the broad categories of cereals, home-grown pulses, and high quality protein reveals an apparent over-supply of organic feed cereals and a clear under-supply for high quality protein crops and other high quality feed sources (Table 5 and Figure 4). In 2002, the EU 25 would have produced enough organic cereals, peas and beans to feed all its organic livestock. Small changes in stock numbers and a reduction in the area for organic pulses would have lead to an under-supply for home-grown pulses in 2003. In both years, the calculation shows an under-supply of high quality protein. This would have been partly covered by fishmeal, used in the Nordic countries, and by feed from conventional sources as permitted according to the Regulation 2092/91.

Table 5: Supply and demand of organic concentrate feeds in 2002 and 2003 (million t)

	All concentrate		Cereals		Home grown pulses		High quality protein	
	2002	2003	2002	2003	2002	2003	2002	2003
Supply								
Production (3t/ha)	2.97	3.06	2.65	*2.80*	0.33	*0.26*		
% Animal feed			55%	55%	90%	90%		
Supply for feed	**1.75**	**1.78**	**1.45**	**1.54**	**0.30**	**0.24**	**-**	-
Demand								
Ruminants	0.64	0.67	0.45	0.47	0.19	0.19	-	-
Pigs	0.20	0.17	0.13	0.12	0.03	0.03	0.03	0.03
Poultry	0.30	0.30	0.15	0.15	0.08	0.07	0.07	0.08
Overall demand	**1.14**	**1.14**	**0.74**	**0.74**	**0.30**	**0.30**	**0.11**	**0.11**
Balance of supply and demand								
Balance A	**0.61**	**0.64**	**0.71**	**0.80**	**-**	**- 0.06**	**- 0.11**	**- 0.10**
Area equivalent (1000 ha)	*203*	*212*	*238*	*266*	*-0.003*	*-19.1*	*-35.7*	*-35.3*
Balance with higher yield assumption								
Production (3.5 t/ha)	3.47	3.57	3.09	*3.27*	0.38	*0.30*	-	-
Supply for feed	2.04	2.07	1.70	*1.80*	0.34	*0.27*	0	*0*
Balance B	**0.90**	**0.93**	**0.96**	**1.06**	**0.04**	**- 0.03**	**- 0.11**	**- 0.10**
Change to Balance A (m tonnes)	*0.29*	*0.29*	*0.25*	*0.26*	*0.04*	*0.03*	*-*	*-*
Balance with modified rations for pigs and poultry								
Demand modified pigs and poultry only	1.13	1.13	0.74	0.74	0.34	0.33	0.05	0.05
Balance C	**0.62**	**0.65**	**0.71**	**0.80**	**- 0.04**	**- 0.09**	**- 0.05**	**- 0.05**
Change to Balance A (m tonnes)	*0.01*	*0.01*	*0.00*	*- 0.00*	*- 0.04*	*- 0.03*	*0.06*	*0.05*
Balance with modified rations all animals								
Demand with modified rations all species	0.95	0.95	0.58	*0.58*	0.32	*0.32*	0.05	*0.05*
Balance D	**0.80**	**0.83**	**0.87**	**0.96**	**- 0.02**	**- 0.08**	**- 0.05**	**- 0.05**
Change to Balance A (m tonnes)	*0.19*	*0.19*	*0.16*	*0.16*	*- 0.02*	*- 0.02*	*0.06*	*0.05*

Source: Own data



Source: Own data

Figure 4: Calculated balance of demand and supply of organic concentrate feed in the EU 25 for 2002 and 2003 (million tonnes)

These balance calculations can provide no more than an estimate of the situation.They carry considerable uncertainty due to gaps in the availability of data and to the use of very broad livestock categories and of uniform rations throughout the whole of the EU 25, which disregards the likely regional and breed-related variations in diets and feed intake. For example, concentrate intake for organic dairy cows is considerably lower in some mountain regions, where no cereals are grown.

To compensate for this uncertainty, a number of calculations with changed assumptions were carried out (see Table 5). Balance B shows the impact of a higher yield assumption of 3.5t/ha for all crops (cereals and pulses). Under such conditions, the supply of organic feed cereals would be even greater than the demand, and the deficit for home-grown pulses in 2003 would have been reduced by about 50%.

In Balance C (Figure 6 and Table 5), it is assumed that pigs and poultry are fed with modified rations to cope with 100% organic feed, as were set out in Table 2. Under these assumptions the deficit for high quality protein could be reduced to approx. 50,000 tonnes (16,000 ha). However, such changes would lead to a slight increase in the demand for organic feed cereals and, in particular, to increases in the demand for home-grown pulses that would result in a greater deficit for the latter.

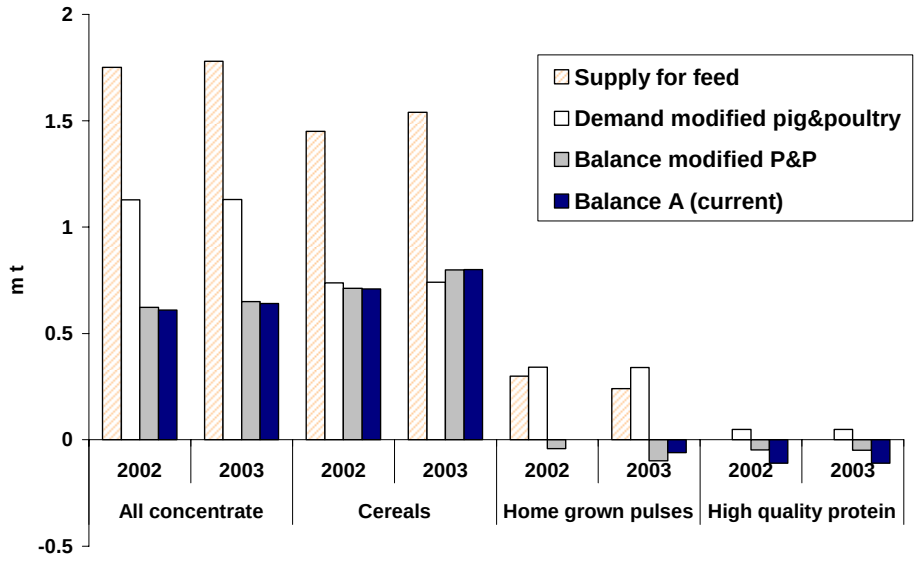


Figure 5: Balance of demand and supply based on modified rations for organic pigs and poultry, EU 25 for 2002 and 2003 (million tonnes)

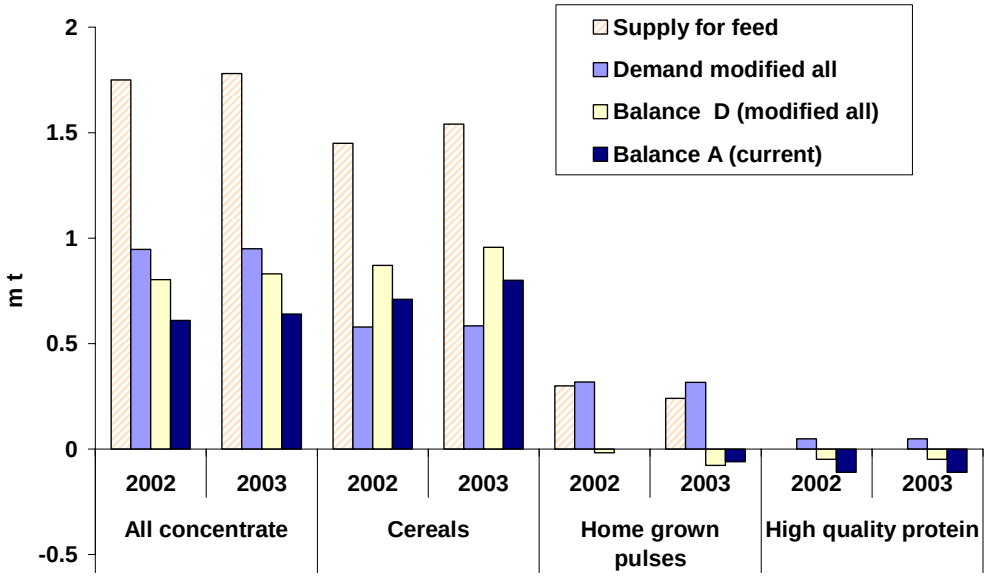


Figure 6: Balance of demand and supply based on modified rations for organic pigs, poultry and dairy cows, EU 25 for 2002 and 2003 (million tonnes)

Finally, Balance D (Figure 6) shows the impact of changes in the rations for all animals, including in the diet for dairy cows. It was assumed that the intake of concentrate feed for dairy cattle would be reduced (in line with organic objectives), but the proportion of protein would increase. Compared with the calculated balance

based on current rations, these conditions would result in a reduction in the overall demand for concentrates and a greater positive balance for cereals. Under these assumptions, a deficit for home-grown protein sources would have occurred in both years. The balance for high quality protein is not affected by the assumed changes to the diet of dairy cows.

Conclusions

In response to the question of the balance between supply and demand for organic concentrate when feeding 100% organic diets to all organic animals, the following tentative conclusions can be drawn.

- Organic livestock currently kept in the EU would require a total of approximately 1.1 million tonnes of concentrate feeds. 65% of this demand is for cereals, 26% for pulses that could be grown in most regions of the EU, and 9% for high quality protein sources.
- It appears that, in 2002 and 2003, the EU would have grown more than sufficient organic cereals to feed all organic livestock on a 100% organic diet. There appears to be a surplus which would allow for increases in stock numbers also to be fed organic cereals. However, the main cereals producing countries are not necessarily those that also keep most organic livestock, so regional imbalances might well occur.
- Under the assumed feed rations, there would have been a sufficient supply of home-grown pulses in 2002, but because of a reduction in the area of pulses, a deficit would have occurred in 2003.
- In both years, for the rations of pigs and poultry, there would have remained a calculated under-supply of high quality protein sources of approx. 100,000 tonnes (33,000 ha). This is equivalent to 9% of the total calculated demand for concentrated feeds. In the past regime, this would have been supplied by protein from conventional sources and by fishmeal in the Nordic countries.
- Through the use of modified rations for pigs and poultry, this deficit for high quality protein could be reduced by about 50% to approx. 50,000 tonnes (16,000 ha). However, such changes would lead to an increase in the demand for organic feed cereals and for home grown pulses. For cereals, the supplies are sufficient to cover such change, but the higher demand would increase the deficit for home grown pulses.
- Because of their high overall proportion of feed demand, changes in the ration for organic ruminants (for example increased protein content or reduced concentrate intake) would have an impact on the overall availability of organic concentrate feeds.
- It appears necessary to identify those alternative organic sources of high quality protein that could be utilised in the EU, both from plant origin (pulses with better protein quality) and also from animal origin (e.g. from milk, fish), and how operators could be encouraged to make use of them.
- In the light of the calculated surplus in the availability of organic cereals in the EU, producers could be encouraged to modify crop rotations with the aim to produce more pulses or oil seeds. Pulses and oilseed would act as break crops in rotations that rely heavily on cereals, and some crops, for example oil seed rape, would provide a high quality protein source and hence increase the supply in protein rich feedstuffs for organic livestock production.

- However, much organic livestock is fed on ready-mixed concentrate feeds, which points to the importance of feed suppliers in setting trends for the future. An increase in the price for organic crops that could be used as feedstuffs is likely to stimulate such changes to land-use, but there may also be some technical problems that need to be overcome.

It is importance to note that the calculated overall balance is influenced by the assumed yield for cereals and pulses, the production area of such crops, changes in livestock numbers, and the diet compositions of all species. It does not consider feed sources from animal origin. The value of such calculations would improve with up-to-date statistics of the land-use and animal numbers in organic farming. The Organic Revision project aims to provide further material illustrating how operators can meet the challenge of 100% organic diets in the future.

Acknowledgement

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