The EU animal feed sector: protein ingredient use and implications of the ban on use of meat and bonemeal

by

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1 Introduction

This paper examines the nature of ingredient use in the EU animal feed sector both currently and how this may be affected by the EU Commission's ban on the use of meat and bonemeal (MBM) in animal feed from 1 January 2001. It covers ingredient usage and reasons for use, usage of meat and bonemeal (MBM), the main alternatives to using MBM (and implications) and the scope for the EU growing more oilseeds and protein crops to offset the loss of MBM as an ingredient.

2 European Union compound feed production and ingredient usage

2.1 Overview of feed production and usage

2.1.1 Total production

The EU livestock sector consumes about 327 million tonnes of feed each year[1]. Within this about 137 million tonnes is forage consumed on farms and 190 million tonnes is commercial feed which comprises manufactured compound feed and feed mixed/manufactured by users (eg, integrated poultry producers and some larger farms). The manufactured compound feed production sector produces about 120 million tonnes of output each year (Table 1) – this has been a reasonably stable volume of production over the last several years.

Table 1: EU (15) manufactured compound feed production 1990-99

Year	Production (million tonnes)
1990	108.8
1991	114.4
1992	115.4
1993	118.7
1994	118.6
1995	119.6
1996	121.4
1997	120.5
1998	121.5
1999	122.7

Source: FEFAC Feed & Food Statistical Yearbook, 1999

2.1.2 Production by country

The main producers of compound feed in the EU are France, Germany, Spain, the Netherlands and the UK (Table 2). This largely reflects and is related to livestock populations in the respective countries although the Netherlands is also an important producer and trader (exporter) of feed.

[1] Source: FEFAC Feed and Food Statistical Yearbook 1999

Table 2: EU compound feed production 1999 and 1994: by country (million tonnes)

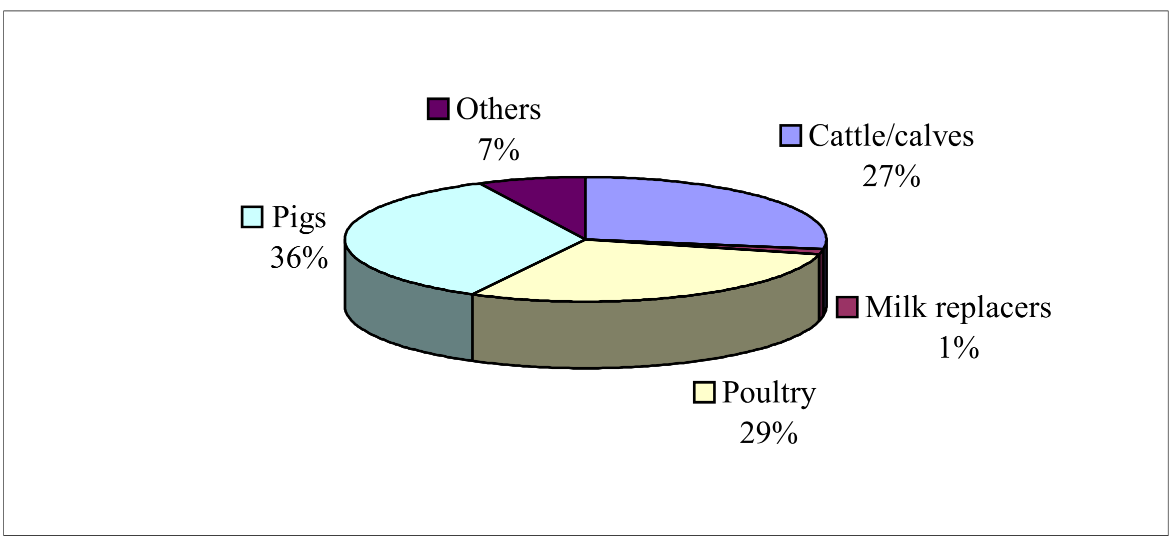
Country	Production (bracketed figures = 1994)
France	23.7 (21.3)
Germany	18.8 (19.1)
Spain	16.5 (14.8)
Netherlands	15.9 (16.8)
UK	12.3 (12.0)
Italy	11.1 (11.7)
Belgium	6.5 (5.4)
Denmark	5.63 (5.8)
Portugal	3.9 (4.0)
Ireland	3.8 (3.4)
Sweden	2.4 (2.3)
Finland	1.2 (1.1)
Austria	1.0 (1.1)
Total EU 15	**122.7 (118.6)**

Source: FEFAC Feed & Food Statistical Yearbook, 1999
Note: Data excludes Greece & Luxembourg

2.1.3 Production by type of feed

Total compound feed production in the EU is broadly split into the three main sub-groupings of cattle/calves, pigs and poultry with these accounting for 27%, 36% and 29% respectively of total production in 1999 (Figure 1). The balance is accounted for by feed for minor species such as sheep, goats, geese and milk replacers (mainly used for veal calves). In volume terms, pig feed is the largest sector (48.2 million tonnes in 1999), followed by poultry feed (35.2 million tonnes) and beef/calves (33.7 million tonnes).

Figure 1: EU compound feed production 1999 by type of feed (Source: FEFAC Feed & Food Statistical Yearbook, 1999)



A profile of the type of compound feed production in the main (five) countries is shown in Table 3. Key points to note include:

- Germany is the largest producer of feed for cattle/calves, the second largest producer of poultry feed and fourth largest producer of pig feed;
- France dominates the production of poultry feed (more than twice the production level of any other country) and is the third largest pig and cattle/calve feed producer;
- The Netherlands is the second biggest pig feed producer (it is also the largest producer of milk replacers reflecting its position as a major veal producer);
- The UK is the second largest producer of cattle/calve feed;
- Spain is the largest producer of pig feed and the third largest poultry feed producer.

Table 3: profile of feed type in the top five EU member states (1999: '000 tonnes)

Feed type	Germany	France	Netherlands	UK	Spain
Cattle/calves	6,896	4,209	3,570	4,437	3,500
Pigs	6,857	6,871	6,900	2,500	7,700
Poultry	4,280	9,592	3,850	3,921	4,100
Milk replacers	182	523	758	13	60
Others	535	2,458	780	1,398	1,120
Total	**18,750**	**23,650**	**15,858**	**12,264**	**16,480**

Source: FEFAC Feed & Food Statistical Yearbook, 1999

2.2 Feed ingredient usage

2.2.1 The main types of ingredients used

A breakdown of the main ingredients used in the manufactured compound feed sector in the EU is shown in Table 4. This highlights the importance of cereals (as a primary source of energy) and oilmeals/cakes (as a primary source of protein) relative to a wide variety of alternative ingredients used.

As indicated, cereals are the main ingredients used in animal feeds (mainly as a carbohydrate energy source) and within this category of ingredient, wheat is the most used cereal (42% of all cereals used in compound feed in 1999) followed by maize (29%) and barley (20%).

Each cereal tends to have a degree of inter-changeability as a raw material ingredient (ie, demand from the feed sector is fairly price responsive). This means that the price of each cereal relative to others plays a major role in determining usage levels in the animal feed sector (for example, wheat incorporation rates have increased over the last five years mainly because the price of wheat has fallen relative to alternatives such as tapioca[2]). Nevertheless, whilst price tends to be the most important factor influencing specific cereal incorporation levels in animal feeds, factors such as digestibility and fibre content are also of significance. This factor means that maize tends to be a preferred feed grain because it is rich in highly digestible carbohydrates and is relatively low in fibre (important for pigs and poultry), but contains a modest amount of protein.

[2] Although in 1999 the use of tapioca increased by about 1.5 million tonnes relative to 1998, mainly because of a fall in tapioca prices.

Oilmeals are the second most widely used group of ingredients in animal feed (mainly as a source of protein). Consequently, most protein sources are considered to be largely interchangeable from the point of view of feed manufacturers and hence, price tends to be the key determinant influencing which meals are used. Nevertheless, different oilmeals have different nutritional values, and some (notably soyameal) are considered to be a necessary ingredient in certain compound feeds (ie, demand is less price responsive than direct substitute ingredients), whilst others tend to be used only when price considerations allow. The main reason for the dominance of soyameal as a protein ingredient is its relatively high protein content of 44-46% (see also sub-section 2.2.4). In contrast, rapeseed meal has a lower protein level (34-38%) and higher fibre content (this means it has a slightly lower level of energy content) relative to soyameal. In 1999 soyameal accounted for 46% of the total volume of protein material used in the EU animal feed sector[3] followed by maize gluten feed, rapeseed meal, pulses and sunflower meal which accounted for 13%, 10%, 9% and 8% respectively of total proteins used in the EU by the feed (compound) industry and home mixers (Table 6).

Animal by-products such as fish and meat & bone meals (MBM) are potential substitutes for oilmeals and maize gluten feed. Further discussion of protein ingredient usage is presented in sub-section 2.2.2 below.

Table 4: EU compound feed production 1999: by main ingredient ('000 tonnes)

Ingredient	Production	% of total ingredients used
Cereals	48,536	39.6
Oilmeals and cakes	31,017	25.3
Co-products from the food industry (eg, brewers grain, citrus pulp, molasses)	17,130	14.0
Tapioca	4,469	3.6
Pulses	3,918	3.2
Minerals, additives & vitamins	3,894	3.2
Meat & bonemeal	2,414	2.0
Dried forage	2,160	1.8
Oils/fats	1,998	1.6
Dairy products (notably skimmed milk)	1,606	1.3
Other ingredients	5,558	4.8
Total	**122,700**	**100**

Source: FEFAC Feed & Food Statistical Yearbook, 1999

In relation to ingredient usage about 35% was derived from imported sources of supply (Table 5). More specifically:

- Almost all of the cereals imported are maize. This volume enters the EU mainly in Spain and Portugal and derives from an EU import duty (duty-free) concession granted on 2 million tonnes of maize plus a further 0.5 million tonnes at a reduced import duty rate. This concession was provided as 'compensation' to third country suppliers (notably the US) when Spain and Portugal joined the EU in 1986 and effectively reflects the volume of (US) imports into these two countries prior to their EU membership. Outside of this import duty concession, the imposition of import duties on third country derived maize would make such a feed ingredient uncompetitive relative to internal EU sources of supply;

[3] Including both manufactured compound feed and feed mixed on-farm.

- Maize gluten feed. This is a co or by-product of the wet milling of maize (for starch manufacturing mainly) and therefore has a relatively high protein content (it has an average protein content of about 21-22% and is mainly used in ruminant feed). It therefore competes as a major protein source in animal feed and is the second most widely used protein source used in the EU feed sector[4] after soyameal. Its main attraction from the import perspective is that it can enter the EU duty-free;

- Maize germ meal is also a by-product of the wet milling process but is the by-product of the crushing of the germ part of the maize grain (to extract maize oil) rather than the by-product of all parts of the grain (including hulls and grits) from where gluten feed is derived. The germ meal has a protein content of about 60% and is mainly used as a protein source in the poultry sector;

- Brewers grains are essentially the by-products of the mashing stage of brewing (where the primary aim is to convert starch into fermentable sugars and then convert these sugars into alcohol). The main constituent parts are derived from the cereals used in brewing which are mostly barley, maize and wheat. The material, although low in protein and energy content is a useful and cheap 'filler' ingredient;

- Molasses: a by product of sugar manufacturing and mainly used as a cereal substitute;

- Oilmeals: soyameal is the main meal imported mostly as a source of protein: see below for further discussion;

- Fishmeal: an alternative source of, mainly protein. This has a high average level of protein (about 65%);

- Pulses: these mainly comprise peas, beans and to a lesser extent minority crops such as lupins. Imports, where they occur are mostly from Central Europe into the eastern countries of the EU (high cost of transport inhibits transhipment on a wider scale);

- Tapioca: this is essentially a cereal (energy source) alternative and derives mainly from Thailand. It is widely used in the Dutch sector.

Table 5: Imported feed ingredients used in EU manufactured compound feed (1999: '000 tonnes)

Ingredient	Volume imported	% of total imported
Oilmeals	22,230	52.3
Maize gluten	5,000	11.8
Tapioca	4,250	10.0
Molasses	3,200	7.5
Cereals	2,300	5.4
Fruit waste	2,050	4.8
Pulses	1,020	2.4
Beet pulp	800	1.9
Brewers grains	750	1.8
Fishmeal	775	1.8
Maize germ meal	120	0.3
Total	**42,495**	**100**

[4] A total of about 7 million tonnes are used in the EU feed sector annually of which about 5 million tonnes are imported.

Source: FEFAC Feed & Food Statistical Yearbook, 1999

2.2.2 Protein use in the EU animal feed sector

As indicated above, soyameal dominates the use of proteins used in the EU animal feed sector accounting for 46% of the total volume of protein material used and 53% of total usage in protein equivalents (ie, it has an average protein content of 45%). Of the other protein sources used (Table 6), the main features are:

- Maize gluten feed: whilst this is the second most important protein ingredient used (13%), its low level of protein relative to other sources means that it accounts for only 7% of total protein equivalent used;

- Alternative oilmeals, notably rapemeal and sunflower meal account for broadly similar levels of usage in terms of volume of product used and protein equivalent (ie, whilst rapemeal is the second most used oilmeal after soyabean meal, in protein equivalent, its usage is about the same as for sunflower and other meals – reflecting its slightly lower protein content than alternatives;

- Pulse crops such as peas and beans account for about 9% of total protein material used but only 6% of total protein equivalent used;

- Meat and bonemeal usage was about 2.4 million tonnes in 1999 (4% of total protein material used). However, as it has a relatively high protein level (55%), it accounted for 6% of total protein used in protein equivalent terms. Usage of MBM has, however fallen by about 30% since 1995 – this partly reflects the ban on its use in the UK, which was until 1996 (when a ban was introduced) using annually 100,000-140,000 tonnes. MBM use is mainly concentrated in the poultry sector[5];

- Fishmeal has the highest protein content of all of the protein ingredients used (65%). In 1999, about 0.9 million tonnes were used in the EU animal feed sector (2% of total protein material or 3% in protein equivalent terms).

Table 6: Use of protein material by the EU animal feed sector (1999: '000 tonnes)

Protein source	Volume of material used	Volume in protein equivalents
Soyabean meal	26,500	11,925
Rapeseed meal	5,600	1,904
Sunflower meal	4,600	1,840
Other meals	4,500	1,800
Pulses	5,400	1,458
Meat & bonemeal	2,400	1,320
Fish meals	900	585
Maize gluten feed	7,500	1,650
Total	**57,400**	**22,482**

Sources: Fediol, Eurostat, Eura, Fefac 2000 (supplied by Fefac)
Note: includes both manufactured compound feed and use by home mixers

In terms of the origin of these protein materials used, about 30% are derived from EU sources of supply although the share of EU sources varies widely by protein ingredient. Only 3% of the

[5] Source: Fefac

total soyameal used derives from EU sources of supply (half a million tonnes), highlighting the import dependence of the EU. Of the other main oilmeals used, 90% of rapeseed meal and 35% of sunflower meal is derived from EU supplies. In relation to the other sources 87% of pulses come from EU sources, all of the MBM, 55% of the fishmeal and 20% of the maize gluten feed were obtained from EU sources of supply.

2.2.3 Protein prices

A summary of recent UK protein prices is presented in Table 7. This highlights:

- The wide range in prices of raw ingredients, with rapemeal and maize gluten being the lowest priced ingredients, then soyameal and the most expensive being fishmeal;

- When converted to protein equivalents the range of prices narrows significantly. The most expensive ingredients are soyameal and fishmeal, with the lowest priced ingredient being rapemeal;

- There has been increases in prices of almost all ingredients (MBM excepted) since the ban on MBM use was first proposed and/or unilaterally introduced in countries such as France and Germany. This has been between 10% and 20% for most protein sources.

Table 7: UK protein prices November/December 2000

Ingredient	Price (euros/tonne)	Price (euros/tonne as protein equivalent)	% change in price Nov 15 2000 to Dec 6 2000
Soyameal 44% protein	267-272	610-618	+14%
Rapemeal 36% protein	174-181	483-502	+20
Maize gluten feed 23% protein	129-130	561-565	+10
Fishmeal 65% protein	566-629	567-629	+10
MBM 55% protein	482-517	482-517	-70 (continental Europe)
Synthetic lysine	2,240	Not applicable	+40
Synthetic methionine	3,360	Not applicable	No change

Source Agricultural Supply Industry various Nov/Dec 2000 editions (MBM source: Fefac (for continental Europe)
All prices are South East UK bulk quotes

2.2.4 Ingredient composition: factors of influence

The composition of compound feed is determined by three main criteria:

- Price of the available ingredient;
- Nutritional value;
- Specific requirements of the livestock to be fed.

The price is the most important factor determining which feed ingredients and what quantities are incorporated into a particular feed (within nutritive limits). Hence it is the price of one protein ingredient relative to another protein ingredient that is of key importance (see Table 7). This is not surprising, when about 80% of the cost of an animal feed is accounted for by the ingredients and feed costs[6] account for about 80%-90%, 75%-85% and 70%-80% respectively of total

[6] Including forage costs.

variable costs of production for poultry reared for meat, dairy farmers and pigs. As such, the use of least cost feed formulations[7] is a widespread practice in the feed sector throughout the world.

The nutritional composition of feed will vary as any given ration mix serves specific livestock types. Thus it varies by animal type, age of animal and the purpose it is being raised (eg, eggs, meat, milk). In general, non-ruminants like pigs and poultry require protein rich feeds whilst ruminants require feeds with higher fibre and energy content.

In terms of preferences for different protein sources, soyameal is the most used source and is generally considered as the standard against which alternatives are measured against. General preference for soya reflects the following:

- Its high level of protein relative to all other sources (with the exceptions of fishmeal and MBM);
- Abundant and consistent availability;
- Consistent price competitiveness relative to alternatives – this does, however vary with time;
- It has a higher level of lysine (but slightly lower levels of methionine and cystine) than other vegetable-based products like rapeseed meal. Overall these are the amino acids most deficient in cereals hence the desirability for incorporating oilseeds with cereals. Soya's higher level of lysine than other protein-based vegetable alternative like rapeseed meal means that overall (and despite slightly lower levels of methionine and cystine) it has a higher level of digestibility than other vegetable-based protein meals used in a feed ration. It is therefore particularly attractive as an ingredient for feeds used in the pig and poultry sectors[8]. In the ruminant sector, this is less vital and hence other meals like rapeseed meal tends to be more readily substituted for soya in the ruminant feed sector. A summary of some of the key features of various protein sources is presented in Table 8.

Table 8: Main protein sources used in animal feed: some key features

Protein source	Comments (relative to soya)
Soyameal	Protein 44%-46%, lysine 2.8%, good palatability. Incorporation rate of 20% common in pig feed
Rapeseed meal	Lower protein level (34-38%) lower lysine level (2.27%), slightly higher levels of methionine and cystine, higher fibre level than soya. Can be used as substitute for soya (eg, up to half of soya used in pig feed could technically be substituted), not a preferred ingredient in the poultry sector
Sunflower meal	Lower protein level (35%-40%), lower lysine (1.68%)
Maize gluten feed	Lower protein level (23%), lysine (0.64%)
Fishmeal	Protein (63%-68%), lysine (4.74%)
MBM	Protein (51%-55%), lysine (2.89%)
Peas & beans	Protein (27%)

[7] Using mathematical programming techniques such as linear programming.
[8] Rapeseed meal is also considered by some to adversely affect meat quality (flavour) when used in poultry finisher rations.

3 Possible impact on feed ingredient use of the ban on meat and bonemeal (MBM) use

With the publication in November 2000, of test findings that the first cases of bovine spongiform encephalopathy (BSE) had been found in Spain and Germany, and BSE-infected meat might have entered the human food chain in France, the EU has taken a number of measures designed to address these issues. One of these measures is the banning of the use of meat and bonemeal in animal feed rations for all livestock for a period of six months from 1 January 2001 (use of fishmeal in ruminant feed is also banned). This ban reflects the linking of BSE and the human disease, new variant Creutzfeldt-Jacob disease (vCJD) to the feeding of BSE-infected meat and bonemeal to cattle in the UK[9].

Whilst the ban is currently temporary, it is likely that it (or substantial parts of the ban) will become permanent.

3.1 The UK experience

This sub-section examines what changes were made to feed ingredient use in the UK animal feed sector after the UK banned the use of MBM in all animal feed for cattle/calves, pigs and poultry in April 1996[10]. As such, it may provide some indications of how the EU-wide ban introduced for the period of six months beginning 1 January 2001 may develop.

Table 9 shows the breakdown in ingredient use by the UK manufactured compound feed sector[11] in the 12 month periods prior to and after the ban on MBM use was introduced in April 1996. This shows the following key features:

- Total production of manufactured compound feed did not fall significantly (a decrease of only 2% in the 12 month period after the ban was imposed (and more importantly after the public statement of the connection between BSE and new variant CJD which resulted in a significant fall in the level of consumption of beef). This largely reflected increased demand from the pig and poultry sectors (largely associated with a consumer preference switch away from beef and to pig and poultrymeat) and recovery in beef consumption after a few months (initially consumption fell significantly and then recovered to a level that was only 5-10% below the level prior to March 1996);

- The volume of MBM material that had to be replaced with alternatives was about 142,000 tonnes of protein rich ingredients or 1.3% of total ingredient use;

- In the 12 month period after the ban was introduced, an additional 48,000 tonnes of soyameal was used (an increase of 4.8%). The relative importance of soyameal as an ingredient therefore rose from 9.3% to 9.9% of total ingredient usage;

[9] Wilesmith et al (1988), Vet Rec 123, 638-644.

[10] The EU's ban introduced from 1 January 2001 introduces only one new element not previously applicable in the UK – the ban on the use of fishmeal in ruminant feed.

[11] This excludes home mixing use and production by integrated poultry producers, for which detailed and disaggregated data to this level is not available. The omission of data on integrated poultry producers is the main reason why the total compound feed production figures in this section are significantly less than the figures presented in section 2.

- Other protein rich ingredients that experienced an increase in usage and an increase in their relative importance in the 12 months following the ban were fishmeal (+21,000 tonnes), minerals (+39,000 tonnes) and sunflower meal (+5,000 tonnes)[12];

- Usage and the relative importance of rapeseed meal, other oilseed meals and maize gluten fell (eg, a fall of 149,000 tonnes for rapeseed meal use). This was probably, mostly due to price factors (ie, the price of these meals rising relative to the price of soyameal, sunflower meal and fishmeal);

- Use of protein crops (peas and beans) also fell in the 12 month period after the ban. As with rapeseed meal, this decline in usage was probably caused by adverse movements in the price of these protein crops relative to the price of soyameal, sunflower meal and fishmeal.

Overall, the MBM ban in the UK in 1996 resulted in a switch to mostly vegetable-based protein ingredients, of which soyameal was the main beneficiary. Additional use of fishmeal and of minerals (to compensate for amino acid and mineral deficiencies that vegetable-based meals have relative to MBM) also occurred. It should, however be recognized that these changes do not include changes amongst home mixers and by integrated poultry producers. Changes in these user sectors are likely to have been similar and additional to the changes referred to above. The latter of these two sectors was also probably one that was affected more than the average, given the reported concentration of MBM use in the poultry feed sector.

Table 9: Feed ingredient use in the UK manufactured compound feed sector before and after the MBM ban in 1996 ('000 tonnes)

Ingredient	12 months to ban (to March 96)	12 months from ban (Apr 96-Mar 97)	% share of total ingredient use before ban	% share of total ingredient use after ban
Wheat	2,487	2,672	23.2	25.5
Barley	793	883	7.4	8.4
Oats	39	38	0.4	0.4
Maize	82	82	0.8	0.8
Rice bran	130	115	1.2	1.1
Maize gluten feed	564	476	5.3	4.5
Cereal by-products (from food and drink sectors)	1,101	1,083	10.3	10.3
Whole oilseeds	79	72	0.7	0.7
Rapeseed meal/cake	671	522	6.3	5.0
Soyabean meal/cake	994	1,042	9.3	9.9
Sunflower meal/cake	548	553	5.1	5.3
Other oilseed meal/cake	540	497	5.0	4.7
Field peas & beans	136	121	1.3	1.2
Sugar beet pulp & molasses	688	619	6.4	5.9
Citrus/fruit pulp	123	119	1.1	1.1
MBM	142	Negligible	1.3	0.0
Other meal (blood, feather meal)	27	18	0.3	0.2
Fishmeal	161	182	1.5	1.7

[12] The relative importance of these ingredients rose from 1.5% to 1.7% for fishmeal, 3.4% to 3.9% for minerals and 5.1% to 5.3% for sunflower meal.

Minerals	366	405	3.4	3.9
Oils & fats	220	224	2.1	2.1
Protein concentrates	37	37	0.3	0.4
Other materials	803	731	7.5	7.0
Total	**10,731**	**10,491**	**100**	**100**

Source: MAFF Animal Feed Statistical Notes November 2000 and Statistical Archives

Notes

1. Other oilseeds = coconut, palm kernels, shea and any other oilseed used
2. Other meals = feather meal, dried blood and other animal by-products except fat
3. Protein concentrates = ready prepared products (balancers)
4. Other products include all other material including confectionery by-products.

3.2 Technical and economic factors influencing the MBM ingredient replacement issue

3.2.1Technical issues

Oilmeals and protein crops

Soyameal has the highest level of protein out of all oilseeds and protein crops generally available and used by the EU animal feed sector. It is also a preferred protein source, especially in the pigs and poultry sectors because of its relatively higher level of digestibility compared to alternatives such as rapeseed meal (this contributes to better feed conversion rates for the livestock producer and hence lower costs of production). Relative to MBM use, soyameal (and other vegetable-based meals) requires supplementation with synthetic amino acids (mainly lysine, methionine) and di-calcium phosphate. The precise amount of 'supplementation varies according to the vegetable-based ingredient used and the type of feed being manufactured (eg, layers, broilers, piglets, pigs for fattening, dairy cows), however a broad magnitude figure for change[13] is that there would be doubling of the requirement for use of synthetic amino acids in the feeds where MBM had formally been used[14].

Fishmeal

This is the protein ingredient with the highest level of protein (about 64/65%) and is the most expensive per tonne (about €567-€629/tonne in November 2000). It is mostly used in the pig and poultry sector for small/young animals (ie, chicks, piglets).

Feasibility for switching ingredients

Technically there is no problem in switching from MBM to alternative sources of protein material, especially vegetable-based protein sources that might derive from a variety of oilseed meals, protein crops such as peas and beans and maize gluten feed. Where deficiencies exist (eg, relating to essential amino acids and minerals) these can be added from synthetic sources, if necessary. Whilst this highlights the technical feasibility of switching to a variety of alternative sources, it is ultimately economic factors that determine what mix of ingredients are and will be used. This is not surprising given the importance of feed costs within total variable production costs to livestock farmers and the importance of ingredient costs in the total cost of production of compound feeds. This issue is discussed further in the sub-section below.

[13] Source: qualitative view of a representative of Fefac, himself recalling the qualitative perspective expressed by an animal nutrition specialist.

[14] Following the UK ban in 1996, the usage of di-calcium phosphate increased from 90,000 tonnes to 150,000 tonnes (Source: P Blanchard quoted in Agricultural Supply Industry 15 December 2000).

3.2.2 Economic issues

3.2.2.1 Availability of materials
This plays an important role in influencing ingredient use. Regions with good port facilities and access to relatively low cost non-cereal feed ingredients like the Netherlands, Northern Germany, Northern France, Eastern England, parts of Northern Italy and Brittany have developed highly intensive livestock production systems which rely extensively on bought-in compound feeds. In contrast, those regions further away from major ports (eg, Bavaria, large parts of France, Northern England and Scotland tend to feed more of the crops generated by farms themselves and incorporating bought-in supplements for mixing on-farm). Examples of relevance include:

- The Netherlands which has the lowest level of cereal incorporation (about 20%) in its animal feed sector (relative to Spain which has about 50%). This largely reflects its proximity to Rotterdam where non-cereal feed ingredients like tapioca and protein sources like soyameal are readily available at competitive prices;

- Similarly in the UK (and Benelux countries), there are relatively high levels of use of food and drink industry by-products and brewers grain, rice bran etc because of the ease of availability from local brewing/distilling businesses, food milling and manufacturing industries;

- Fishmeal use, although mostly used in pig and poultry feed, is also used in ruminant feeds (mainly young calves and lambs) in regions with close proximity to fishing ports and processing plants (eg, North East Scotland);

- Rapeseed and sunflower meal use: the extent to which these are incorporated in feed is closely related to local availability. Thus, sunflower is more widely used (as a substitute for soyameal) in regions of Spain, Southern France and Italy, whereas rapeseed meal is more commonly used in Northern Europe (notably the UK, Northern France and Germany).

In sum, usage of most ingredients like oilseed meals and protein crops is linked to availability within the EU (ie, what EU farmers grow) or whether additional supplies/alternatives can be imported at competitive prices. Clearly when imports are to be considered as an alternative source, the distance of a production base from a port significantly affects the competitiveness of the imported raw material.

3.2.2.2 Growing more oilseeds and pulses in the EU
Drawing on sub-section 2.2.2, the replacement of MBM in the EU animal feed sector will require the equivalent of 1.32 million tonnes of protein material from alternatives sources. Some of the alternative sources of supply are briefly discussed below.

Soya
In soya equivalents, the current level of MBM use is equal to about 2.93 million tonnes of soyameal and 3.76 million tonnes of soyabeans. Relative to current EU use this is:

- Equal to about 11% of total annual EU soyameal use. As 97% plus of current soyameal derives from either imported soyameal or meal derived from imported soyabeans, this would be roughly equal to the EU importing an additional 2.9 million tonnes of soyameal or an additional 3.7 million tonnes of soyabeans for crushing[15];

- Equal to the EU growing nearly three and half times more than the current area and production level (Table 10).

Rapeseed
Replacement of the MBM material would require the EU to produce or import an additional 3.9 million tonnes of rapeseed meal or grow an additional 6.8 million tonnes. Relative to the current level of planting and production, this would represent an increase in the area planted of 2.2 million ha (+72%: Table 10).

Sunflower
In sunflower meal equivalents, the current level of MBM use is equal to 3.3 million tonnes of sunflower meal and 6.23 million tonnes of sunflower. Relative to current EU this is equal to a doubling of the current area planted and production level (Table 10).

Pulses
In pulse crop equivalents, the current level of MBM use is equal to about 3.3 million tonnes of pulse crops. Relative to the current crops of peas and beans in the EU:

- An additional 852,000 ha of peas would need to be planted (+94% on the 2000 crop area of about 1 million ha); OR

- There would need to be a fivefold increase in area planted to beans (+1.2 million ha relative to the current area of 0.22 million ha).

Total requirements
Overall, the data presented above (and in Table 10) highlights the very small size of the soya crop in the EU and the impracticality of the EU deriving protein replacement for the MBM ban from domestic soya production. It also highlights the very large increases in areas devoted to, more widely grown oilseeds (rapeseed and sunflower) and protein crops (peas) that would be required if the EU were to replace the MBM material currently used with EU grown, vegetable-based material. Thus, an additional 850,000 ha of peas or an increase in the oilseed area of between 1.1 million ha (if all requirements came from soya) and 4 million ha (if all requirements came from sunflower) would be required. It should, however also be recognized that if the EU were to pursue any active policy to encourage increased oilseed production, the expansion in area planted would be constrained by the EU's WTO commitments to limit the area of oilseeds grown for food/feed use to a maximum of 5.842 million ha (reduced to 4.93 million after taking into account the provision for 10% set-aside which currently applies). Relative to the 2000 area planted to oilseeds (4.55 million ha for food/feed uses) this provides for a maximum of only an additional 383,000 ha of oilseeds – significantly less than the MBM shortfall referred to above.

Table 10: MBM replacement implications for oilseed and pulse production in the EU

Crop	Meal equivalent required ('000	Crop equivalent required ('000	EU production 2000 ('000 tonnes)	EU average yield (average of 1999 &	EU area 2000 ('000 ha)	Additional area required to replace	% change in area required

[15] Additional volumes of beans would only be imported for crushing if crushers had a) adequate capacity to increase crushing throughput and b) had markets available for the soya oil produced from the additional crush.

	tonnes)	tonnes)		2000: tonnes/ha)		MBM ('000 ha)	
Soyabeans	2,933	3,761	1,125	3.31	340	1,135	+334
Rapeseed	3,882	6,811	9,175	3.08	3,063	2,214	+72
Sunflower	3,300	6,226	3,475	1.57	1,990	3,971	+200
Pulses	N/a	3,300	3,807 (3,209 peas, 577 beans)	3.87 (peas), 2.75 (beans)	1,197 (980: peas, 217: beans)	852 (if all peas) or 1,199 (if all beans)	+94 if all peas, +553 if all beans

Notes:

1. Protein equivalent required to replace = 1.32 million tonnes.
2. N/a = not applicable.
3. 2000 area and production figures (source: Coceral estimates October 2000). For oilseeds this includes areas planted for non food/animal feed uses (about 842,000 ha)

Economic incentives for planting oilseeds and pulses in the EU

Having examined the magnitude of the changes in domestic production levels that would be (technically) required for the EU to replace MBM derived protein material with domestically grown vegetable-alternatives, it is also important to consider the nature of economic factors affecting the farm level decision to plant oilseeds or pulses relative both to each other and alternatives (eg, cereals).

Essentially, the key determinant influencing whether a particular arable crop (an oilseed, pulse or cereal crop) is planted relative to alternative crops or enterprises depends on the relative margins derived from different crops and enterprises that might reasonably be taken up as an alternative.

In the main arable growing regions of the EU, where soya might be taken up[16], the main alternative crop to irrigated soya is irrigated maize (or rice in some regions) and the main alternative to non irrigated soya is non irrigated maize, sunflower, durum wheat or soft wheat. For rapeseed and pulses, which have traditionally been concentrated in more northerly parts of the EU[17], the main alternatives are cereals (mainly soft wheat), rapeseed and pulses. As such, Table 11 shows the level of gross margins derived from some of the key crops in France before Agenda 2000 and currently (part way through the Agenda 2000 reforms). Table 11 highlights the following:

- In 1998 the margins derived from maize were significantly higher than from soya (in both cases of comparing irrigated or non irrigated crops). The margins derived from sunflower, durum wheat and soft wheat were also significantly higher than those earned from growing soya. This highlights an underlying reason why the area planted to soya in France has been very low (only 81,000 ha in 2000 and about 100,000 in 1999). The most profitable cereal crop to grow has been maize where irrigation is used and maize, durum wheat or soft wheat when irrigation is not used. Consequently, the planting of oilseeds and pulses has probably largely been for break crop purposes, with rapeseed being the most profitable break crop, followed by peas and lastly sunflower;

- By 2000, part of the way through the implementation of the Agenda 2000 reforms, the policy changes have further re-inforced the margin advantages inherent in cereal crops relative to oilseeds and pulses, with the margins derived from oilseeds experiencing the

[16] Almost all of the EU soya area is in Italy (240,000 ha: 70%) and France (81,000 ha: 24%).

[17] The main producers of rapeseed are Germany, France and the UK, which accounted for 35%, 40% and 13% respectively of the total EU rapeseed area in 2000. The main producers of pulses were also France, Germany and the UK, which accounted for 41%, 14% and 19% respectively of the total EU pulse area in 2000.

most significant reductions. Given these changes in the relative crop margins it is therefore, not surprising that across the EU, the area devoted to oilseeds and pulses fell in 2000 respectively by 10.8% and 7.7% compared to 1999 (the last year of the pre-Agenda 2000 regime);

- For the next year (harvest 2001), further cuts in the level of (area payment) support for oilseeds will occur[18] (there will be no change in the rate of area payments for pulses). This will make the growing of oilseeds even less attractive relative to cereals (and pulses) than occurred in 2000. As a result the trend towards increased planting to cereal crops (notably soft wheat, durum wheat and maize) may continue, albeit at a less marked trend than previously).

Whilst highlighting that this data is a simplification of the 'real world' (see assumptions in Table 11) faced by farmers (and the 'detailed figures' shown in the table should be treated with caution), the broad implications are that, the EU is in the process of a largely, policy-induced change, away from oilseed and pulse planting and into more cereal production. This suggests that if the EU aims to produce more vegetable-based proteins to replace MBM, the current market and policy incentives are inadequate for the purpose. Either prices of pulses and oilseeds will have to rise substantially, relatively to cereals or the EU will have to offer major (policy) incentives to farmers to grow more oilseeds and pulses (eg, substantially higher area payments). Given that prices of oilseeds and protein crops in the EU are largely determined by market forces and developments on world markets, there is little prospect of prices rising sufficiently to provide the necessary incentive. Although world prices for alternatives to MBM (eg, soyabeans/meal) have shown some recent signs of increasing (partly as a result of increased demand expected post the MBM ban: see Table 7), they have been and are unlikely to be sufficient to encourage a major switch back to oilseed and pulse crops in the EU.

Table 11: Main alternative arable crop margins in France 1998 and 2000 (euros/tonne)

Crop	1998	2000
Irrigated soya	610-915	300-470
Irrigated maize	915-1,065	655-990
Non irrigated soya	460-760	280-450
Non irrigated maize	730-835	630-740
Non irrigated sunflower	665-830	420-520
Rapeseed	855-1,045	660-800
Peas	740-930	710-900
Soft wheat	640-1,005	635-1,000
Durum wheat	810-965	810-965

Source: derived and extrapolated (2000) from Le Clech (Synthese Agricole Production Vegetables, 2nd edition, 1999)
Notes:
1. Margins include provision for area payments
2. Area payments for cereal crops: reference yields and rates applicable derive from the region of Gers
3. 2000 figures derived assuming 1998 costs, 2000 area payments and 1998 prices with the exception of soft wheat and maize prices which are assumed to fall by 7.5% in line with cuts in the support price.

On the policy side there are also a number of constraints that make the likelihood of a major shift to oilseed and pulse crop occurring being very limited. These include the following:

- As indicated earlier the EU has a WTO-related limit on the area it can plant to oilseeds (4.93 million ha for food/feed purposes). Given the current area planted, there is only

[18] Less dramatic than between 1999 and 2000 – between 1999 and 2000 the level of area payment support fell by over 50%, whereas between 2000 and 2001 it will fall a further 11.5%

provision for another 383,000 ha of additional oilseeds that could be grown before support payment penalties would have to be imposed. This would act as a disincentive to plant oilseeds. This level of increased planting is substantially below the additional oilseed area required if the EU were to replace the MBM protein from domestically grown, vegetable-based proteins;

- The budget available for providing support to the agricultural sector has been set (at the Berlin Council of 1999) up to 2006. Within it there is very little (if any) unaccounted for budget or contingency facility (the current year unused/unallocated provision that had existed, of about 1.23 billion euros[19] will now probably be largely allocated to measures associated with BSE-related issues in the livestock sector such as additional funding of beef private storage aid and export refunds for beef. Any provision of additional incentives to plant oilseeds and pulses in the next year or two are, at best likely to be small (eg, not applying the planned cuts in oilseed area payments for 2001);

- If the EU were to provide any additional incentive to grow oilseeds and pulses, this would open the EU to probable challenges at the WTO, after 2003 (when the Peace Clause lapses). At present a major reason cited by the EU Commission for aligning oilseed support payments with those of cereals is to 'make the oilseed payments 'production-neutral'. This, the Commission perceives will allow the EU to remove its WTO oilseeds planting constraint (see above) and make a WTO challenge to the concept of providing area payments support to arable crops less likely. Any move to differentiate oilseed support payments from support payments for cereals or to widen the difference between pulses and cereals is likely to undermine the aims of the Commission vis a vis relations with WTO partners.

Overall, it is likely that if any policy incentive for increased planting of protein or oilseed crops in the EU occurs in the next year or two it will be small. It is also likely to provide no more than a marginal incentive to produce either additional oilseeds or protein crops relative to the 2000 planted areas. Whilst it is extremely difficult to suggest an average level of incentive that would be required[20], a benchmark comparison is the level and range of support payments applicable before Agenda 2000 was introduced. These involved the provision of area payments for oilseeds that were about double those applying to the 2000 harvested crop and 8% higher for protein crops. When these levels of support payments were available, the peak year for oilseed and protein crop plantings was 1998 when there were 6 million hectares of oilseeds and nearly 1.45 million hectares of protein crops. Relative to 2000 production levels this produced about an additional 1.5 million tonnes of protein crops and oilseeds respectively, which would go substantially towards offsetting[21] the MBM deficit. However, given the budgetary constraints faced by the EU (see above), it is extremely unlikely that any significant increase in the level of support payments would be forthcoming. Also in the case of oilseeds, the political (WTO) sensitivity of the nature and level of oilseeds support in the EU probably precludes any form of additional support being forthcoming (even if no budgetary restriction existed).

The net conclusion from the above analysis is that the EU may be able to make a very modest contribution to offsetting the protein shortfall of 1.32 million tonnes (protein equivalent) from the MBM ban (if, as is likely it were to be made permanent) if it were to increase the level of support

[19] Mainly arising from the euros depreciation against the US dollar. This has reduced the requirements for export (refunds) subsidies.
[20] The level of incentive required will vary by region, specific farm location and crop.
[21] But not eliminating.

for protein crops by, for example 10% although even here, budgetary and political factors[22] will probably prevent this from happening. The recently observed increases in oilmeal prices (Table 7) will also provide a small, positive incentive for increased EU plantings, provided prices do not fall back in the next few months. Nevertheless, even if this stimulates some increased EU planting, the EU will still be faced with a substantial protein deficit for its animal feed sector.

The more realistic and probable way in which the EU will fill the MBM protein shortfall is through increased importation of alternatives. The precise mix of products that will ultimately fill this gap, will however depend on a combination of price and suitability of raw material for different feed types. As soyameal is the preferred vegetable-based alternative, especially in the sector where MBM use has been concentrated (poultry), it is likely that demand for soyameal will be one of the main beneficiaries of the MBM ban. The EU is therefore likely to import somewhere between an additional 1-3 million tonnes of soyameal during the next year (relative to the volume of imports that would otherwise have occurred). Drawing on the UK experience (sub-section 3.1) as a pointer for the likely magnitude of increased demand for soyameal, the increase in demand will probably be at the lower end of this range (ie, about 1 million tonnes). The demand for synthetic amino acids and di-calcium phosphate is also likely to increase significantly (eg, P Blanchard (ASI of 15 December 2000) estimates that the EU will require an additional 400,000 tonnes of di-calcium phosphate to replace phosphates formally obtained from MBM).

4 Summary and conclusions

4.1 EU feed production and usage

The EU livestock sector consumes about 327 million tonnes of feed each year of which 122 million tonnes is manufactured compound feed. Within this, feed for cattle/calves, pigs and poultry account for 27%, 36% and 29% respectively of total manufactured feed output.

4.2 Ingredient use

Cereals are the main ingredient used (accounting for about half of all ingredients incorporated) and oilmeals are the second most important group of ingredients.

Soyameal dominates the use of proteins in the EU animal feed sector accounting for 53% of total protein material used (in protein equivalent terms). No other vegetable protein sources used (maize gluten feed, rapeseed meal, sunflower meal and pulses) come near soyameal in terms of importance (each (individually) account for less than 10% of total proteins used (in protein equivalent terms)). This importance of soyameal reflects a combination of superior technical characteristics and performance as a feed ingredient and its price competitiveness.

MBM usage was about 2.4 million tonnes in 1999 (6% of total protein material used in protein equivalent terms) and fishmeal use was about 0.9 million tonnes (3% of total protein use in protein equivalent terms).

4.3 Origin of EU protein sources

About 30% of the protein requirement is derived from EU sources of supply although the share of EU sources varies widely by protein ingredient. Only 3% of the total soyameal used derives from

[22] It would be reversing some of the changes initiated under Agenda 2000.

EU sources of supply (half a million tonnes). 90% of rapeseed meal, 35% of sunflower meal, 87% of pulses, all of the MBM, 55% of fishmeal and 20% of the maize gluten feed are obtained from EU sources of supply.

4.4 Current prices

Rapemeal and maize gluten are currently the lowest priced ingredients, then soyameal and the most expensive being fishmeal. When converted to protein equivalents the most expensive ingredients are soyameal and fishmeal, with the lowest priced ingredient being rapemeal.

There have been increases in prices of almost all ingredients (MBM excepted) since the ban on MBM use was first proposed (November 2000) and this has been between 10% and 20% for most protein sources.

4.5 Technical issues influencing ingredient substitutability

Compound feed composition is mainly determined by three main criteria:

- The price of ingredients: this is the most important factor with the price of one protein ingredient relative to another being of key importance. This is not surprising, when feed costs account for between 70%-90% of total variable costs of production for poultry reared for meat, dairy farms and pigs;

- Nutritional value: the composition of feed varies by animal type, age of animal and the purpose it is being raised (eg, eggs, meat, milk);

- The specific requirements of the livestock to be fed: in general, non-ruminants like pigs and poultry require protein rich feeds whilst ruminants require feeds with higher fibre and energy content.

Soyameal is the most used and preferred protein source. This reflects its high level of protein relative to all other sources (with the exceptions of fishmeal and MBM), consistent availability and price competitiveness and it has a higher level of lysine than other vegetable-based products like rapeseed meal (giving it a higher level of digestibility). It is particularly attractive as an ingredient for feeds used in the pig and poultry sectors. In the ruminant sector, protein content is less crucial and other meals like rapeseed meal tend to be more readily substituted for soya.

4.6 MBM ban implications

4.6.1 The UK experience

The MBM ban in the UK in 1996 resulted in a switch to mostly vegetable-based protein ingredients, of which soyameal was the main beneficiary (reflecting its technical qualities and price competitiveness). Additional use of fishmeal and of minerals (to compensate for amino acid and mineral deficiencies that vegetable-based meals have relative to MBM) also occurred.

4.6.2 Scope for the EU growing more protein material

The replacement of MBM in the EU animal feed sector will require the equivalent of 1.32 million tonnes of protein material from alternatives sources. This is equal to about 2.93 million tonnes of soyameal or about 11% of total annual EU soyameal use. Alternatively it is the same as EU soya production increasing by three and half times current levels. It is therefore totally impractical for the EU to replace the MBM ban protein deficiency with increased domestic plantings of soya.

Alternatively, very large increases in areas devoted to, more widely grown oilseeds (rapeseed and sunflower) and protein crops (peas) would be required (an additional 850,000 ha of peas or an increase in the oilseed area of between 1.1 and 4 million ha).

For the EU to produce substantially more vegetable-based protein material, EU farmers will require the necessary market and policy incentives to plant more oilseeds or pulses. However, it is clear that the margins derived from soya are significantly lower than other oilseeds, cereals or pulse crops. Also the EU is currently part of the way through the implementation of the Agenda 2000 policy reforms, which are further re-inforcing the margin advantages inherent in cereal crops relative to oilseeds and pulses. Given these changes in the relative crop margins (the area devoted to oilseeds and pulses fell in 2000 respectively by 10.8% and 7.7% compared to 1999) and the further cuts in the level of (area payment) support for oilseeds that will occur next year, the growing of oilseeds will become even less attractive relative to cereals (and pulses).
The clear conclusion that can be drawn is that the current market and policy incentives are inadequate. Either prices of pulses and oilseeds will have to rise substantially, relatively to cereals or the EU will have to offer major (policy) incentives to farmers to grow more oilseeds and pulses (eg, substantially higher area payments).

As EU prices of oilseeds and protein crops are largely determined by market forces (and developments on world markets), there is little prospect of prices rising sufficiently to provide the necessary incentive. Although prices for alternatives to MBM (eg, soyameal) have shown some recent signs of increasing (partly as a result of increased demand expected post the MBM ban), they have been and are unlikely to be sufficient to encourage a major switch back to oilseed and pulse crops in the EU.

In relation to the possible provision of additional policy incentives to grow more protein material, a combination of EU budgetary constraints and the EU's WTO commitments (notably relating to the provision of oilseed specific support that has limited the area of oilseeds that can be planted in Europe) means that if any policy incentive for increased planting of protein or oilseed crops in the EU occurs in the next year or two it will be small and provide no more than a marginal incentive.

Overall, the EU may be able to make a very modest contribution to offsetting the protein shortfall from the MBM ban. Nevertheless, the EU will still be faced with a substantial protein deficit for its animal feed sector. As a result the more realistic and probable way in which the EU will fill the MBM protein shortfall is through increased importation of alternatives.

As soyameal is the preferred vegetable-based alternative (reflecting its technical advantages relative to other vegetable-based alternatives and its price competitiveness), especially in the sector where MBM use has been concentrated (poultry), it is likely that demand for soyameal will be one of the main beneficiaries of the MBM ban. The current, abundant availability of competitively priced soyabeans and soyameal on world markets also means that the EU should be able to replace the (mostly protein) material formally derived from MBM without undue difficulty and at only a modest addition to compound feed costs of production[23]. Drawing on the UK experience as a pointer for the likely magnitude of increased demand for soyameal, there will probably be about 1 million tonnes more soyameal required in the EU per year than would otherwise have been imported.

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[23] Modest relative to the additional costs that would probably occur if a) the EU sought to grow substantially more of its own soya or b) other vegetable-based ingredients were mainly used to replace MBM instead of soya.