Strategies for reducing the negative impacts of soy production

Replacing soy in animal feed

Introduction

Soy is a raw material for the manufacture of a range of animal feed, food and industrial products. It meets a large proportion of the global market for vegetable oil and protein-rich oil meals, on which the world's intensive animal husbandry industry depends. Global production in 2008 was over 222 million tonnes, making it the world's fourth agricultural commodity after wheat, rice and maize. The largest producers are the USA (33%), Brazil (27%) and Argentina (21 %). Soy production has risen sharply over the past decade. As the global demand for meat and dairy products continues to increase, in turn pushing up demand for animal feed, the market for soy is expected to rise to 300 million tonnes within 15 years.

The expansion of soy cultivation has occurred almost exclusively in South America. Although soy production has generated substantial revenue for producers, traders and national economies, it is also causing severe environmental and social impacts. These include deforestation, erosion and soil degradation, land conflicts and human rights violations, slavery, reduced employment opportunities, food insecurity, and health problems and pollution caused by the use of pesticides.[1]

The Netherlands is the second largest importer of soy in the world. In view of the country's importance in the market for soy, various Dutch civil society organizations have joined forces in the Dutch Soy Coalition (DSC) to support and complement the work of their partners in soy producing countries. Our aim is to reduce the negative social and environmental impacts associated with the production, processing and consumption of soy. We are pursuing of this goal in three ways: we are campaigning to reduce the high levels of meat and dairy consumption in the Netherlands, which is the root cause of the problems; we promote more responsible production of soy; and we ask the livestock sector to replace part of the soy in animal feed with alternative feed crops.

This is one of three fact sheets we have prepared to explain why we are pursuing these three goals and provide information on the important initiatives and activities. The fact sheets are: *Responsible soy production*, *Reducing consumption*, and *Replacing soy in animal feed.*

Why replace soy in animal feed?

About 70% percent of all the soy produced in the world is used to feed livestock. In the European Union, this figure is as high as 90%. The global consumption of meat increased from about 26 kilos per person in 1970 to 37 kilos in 2000 and is expected to rise to 52 kilos in 2050. In the same period the consumption of dairy products will increase from 75 kilos per person to 100 kilos. This growing consumption of animal products is driving up demand for soy beans to produce animal feed. The figures show that future demand for soy will inevitably have to be reduced to make more sustainable production of this commodity possible. There are basically two ways to achieve this: by reducing the consumption of (animal) proteins and by replacing soy in compound feed with alternative protein sources. This fact sheet focuses on replacing soy. The fact sheet *Reducing consumption* contains more information on reducing the consumption of (animal) proteins.

Replacing soy in animal feed for EU livestock with European grown protein crops has several additional advantages. At present, the vegetable and animal components of the meat production chains in Europe are partly disconnected. Vegetable proteins for animal feed are mostly produced in South America, whereas livestock production is concentrated around the main European sea ports. The EU depends on imports for almost 80% of its consumption of vegetable proteins, the largest share being soy meal. To make livestock production more sustainable it is crucial to reintegrate the vegetable and animal production components. Closing the nutrient cycles (from feed crops to livestock to manure and to feed crops again) will reduce soil exhaustion and degradation and excess use of chemical fertilizers in South America, and reduce ammonia, phosphate and nitrate pollution in Europe (which is caused by the huge manure surplus).

Replacing imported soy with Leguminosae like peas, beans, lupines and clover grown in Europe delivers advantages for the sustainability of European arable farming as well. Microbes living on

[1] For a detailed explanation of these impacts see 'Soy Big Business, Big Responsibility – Addressing the social and environmental impact of the soy value chain' (DSC, 2008).

the roots of the plants enable Leguminosae to fix nitrogen from the air. These crops therefore need relatively little fertilizer. Moreover, subsequent crops can also be grown using less fertilizer. Finally, an extra crop in the rotation scheme helps to curb pests and diseases and improves the soil.

Animal feed

Three quarters of feed for cows is forage. This is mostly grass but also maize, hay or straw. The forage is supplemented with concentrates. Concentrates are mostly maize glutens and soybean meal, which have a high protein or starch content. The concentrates are mechanically treated and usually pressed into bricks.

Pigs and chickens in intensive husbandry systems are entirely dependent on concentrates; they do not eat forage as they cannot digest it. Concentrates can be byproducts from the food processing industry, but nowadays they are often imported food crops.

Optimizing the combination of ingredients in animal feed is done on the basis of price, but is also related to energy and protein content. It is important to create the right mix of ingredients because cows, chickens and pigs need certain levels of essential amino acids present in different feed crops. They cannot eat too much of the same ingredient either, because they would then consume too many AFNs (Antinutritional Factors), which have a negative effect on digestion. This means that a crop cannot be simply replaced by another; energy, protein and amino acid levels have to be kept constant.

Source: Vellinga, forthcoming; Vahl, 2009

Why is soy the main source of protein in European animal feed?

The total production of compound feed in the EU-27 amounted to 147 million tonnes in 2007. As the total consumption of soy meal in 2007 was 35.8 million tonnes, the average soy meal content of compound feed was 24%. Although the amount of soy used in different types of animal feed can fluctuate strongly due to (relative) price changes, Table 1 gives an indication of the total amount of soy used for different types of livestock and the percentages of soy used in different types of compound feed.

Table 1: Types of compound feed and their soy contents (based on 2007 figures).

Type of compound feed	Estimated soy meal content	Volume of soy meal (1,000 tonnes)	% of EU soy meal
Cattle – meat	13.9%	1,683	5%
Cattle – dairy	10.4%	2,893	8%
Pigs	28.8%	14,815	41%
Poultry – broilers	36.8%	11,389	32%
Poultry – layers	22.4%	3,477	10%
Other animals	16.6%	1,577	4%
Total	**24.3%**	**35,834**	**100%**

Source: van Gelder et al., 2008

There are two main reasons why soy is the main source of protein in European compound feed. The first reason is related to the way the European Common Agricultural Policy (CAP) was constructed in 1962. For most agricultural products, such as cereals, sugar, milk and beef, a "Community preference" was introduced (i.e. an import tax representing the difference between the European price and the world market price). However, due to pressure from the European animal feed lobby and the US, animal feed was omitted from the list and became duty free. Farmers then began to focus on products supported by the CAP (Community preference, intervention, export refunds) and to buy cheap imported feed. As a result, the system soon began to generate large surpluses, not only of animal products but also of cereals, as land that would normally have been used for the production of animal feed was planted with cereals. Feed producers refused to buy these cereals at the high European guaranteed price.

The second reason for soy being the main source of protein in European compound feed is related to the physical qualities of soy. Soy beans have one of the highest protein contents of all agricultural crops: more than 40%. The content of essential amino acids is also especially favorable for poultry and pigs.

Possible alternatives to soy in animal feed:

1. Leguminosae grown in Europe
2. Byproducts of biomass and biofuel production
3. Meat and bone meal
4. Mixed cropping
5. Efficiency gains
6. Duckweed
7. Other options

1. Leguminosae grown in Europe
Soy belongs to the Fabaceae or Leguminosae family of flowering plants. Research on the production of soy suggests that current varieties are not particularly suitable for cultivation in North-West Europe and that soy cannot compete with wheat. Soy is grown on a limited scale in Romania, Italy and France. Other Leguminosae (clover, peas, beans, alfalfa and lupines) grow perfectly well in Europe.

Kamp et al. (2008) found that it is indeed possible to replace some of the soy in animal feed with locally grown Leguminosae like peas, field beans or lupines. Alfalfa (Lucerne) is another possibility. Technically treating (toasting) the crops makes substitution even more suitable.

Cows can digest most Leguminosae and pigs and poultry can eat field beans, peas and lupines. Depending on the age of the pig, the feed can contain between 15% and 60% peas. Beans and lupines are not suitable for piglets and mother animals. Poultry feed can contain up to 50% peas, 10% lupines and between 20% and 30% field beans. These percentages make it possible to completely substitute soy, as compound feed currently contains between 10% and 30% soy. Furthermore, the development of new varieties can improve the physical qualities of these substitutes to make even higher inclusion rates possible.

2. Byproducts of biomass and biofuel production
Rapeseed is currently the most important source of protein grown in Europe and its cultivation is expanding to meet the growing demand for the production of biodiesel. Byproducts of rapeseed oil, rapeseed press cake and rapeseed meal are suitable substitutes for soy. Rapeseed requires higher amounts of fertilizers than soybeans and other Leguminosae. The literature gives a mixed picture on the use of pesticides in rapeseed cultivation. According to Wervel, rapeseed improves soil structure and does not need many chemicals, but Vahl (2009) states that the use of pesticides on rapeseed is higher than for soybeans and other Leguminosae.

Another protein-rich byproduct of bio-ethanol production from grains is dried distillers grain with solubles (DDGS). The supply is especially large in the USA and production will increase in the future. Cows can digest DDGS particularly well and concentrates may contain up to 20% DDGS. Concentrates for pigs and poultry may contain 10% and 5% respectively.

If soy is to be replaced with byproducts from biomass and biofuel production, production of biofuels will have to increase. However, given the sustainability problems of biofuel and biomass, it remains to be seen whether this can be a sustainable alternative.

3. Meat and bone meal
Animal meal used to be an important source of proteins and has a suitable amino acid profile. However, in 2000 the European Union prohibited the use of animal meal due to the BSE crisis (Bovine Spongiform Encephalopathy or "mad cow disease"), which was spread through the use of animal meal from infected animals. In 2005, European discussions started on permitting animal meal to be used in feed under strict conditions, but it unlikely that this will be permitted in the near future.

As a result of the "Stop Fout Veevoer" campaign (stop using "immoral" animal feed) by the Dutch NGO Milieudefensie (Friends of the Earth Netherlands), discussions about reintroducing the use of animal meal also took off in the Netherlands. Animal meal could potentially replace part of the soy used for animal feed, which would also be a more efficient way of using it than at present (it is often burned). Nevertheless, animal meal will remain a sensitive issue as the images of burning piles of animals are still fresh. Moreover, reintroducing animal meal would only be able to replace part of the soy used because the prohibition of animal meal did not lead to full substitution by soy.

Fishmeal is also suitable for animal feed, but as fish stocks are decreasing this is not a sustainable alternative.

4. Mixed cropping
Mixed cropping is not very common in Europe, but is receiving renewed interest because of its – often forgotten – advantages. Growing various crops in one field combines the advantages of the crops and generally makes them more resilient to pests and diseases. Mixed crops can be used to make a full animal feed that is balanced for energy and protein. Various mixes are possible, containing grass, clover, peas, barley, wheat and more. One of the most promising mixed crops is a grass and clover combination.

Grass is a very suitable feedstock for cows. It contains more proteins than maize and is more digestible. The first cut of the year in particular is very healthy. Adding clover delivers additional advantages: the leaves are rich in proteins and easily digestible and the structure of the stems of the red clover improve the efficiency of digestion. If needed, the feed can be supplemented with other crops (wheat, maize meal, linseed). Cows on this diet produce similar or even higher amounts of milk. Moreover, the diet is more sustainable. Clover fixes dioxide in the soil and the mix of grass and clover increases soil fertility and stores carbon. Mixed crops are less suitable for other animals as they do not eat grass.

5. Efficiency gains
The need for soy in animal feed can also be reduced by using it more efficiently. Soy (protein) efficiency is increased by adding feed supplements (like wheat) that improve protein digestion in animals. It is also possible to "toast" the soy, which increases its quality. Another option is to optimize feeding techniques. For example, older animals need fewer amino acids and so they should eat different feed combinations than younger animals. Finally, it is also possible to use more "durable" soybean meal, which receives a special treatment so that proteins are less easily broken down in the rumen and thereby more efficiently digested.

6. Duckweed
Duckweed, or Lemnaoideae, also has potential to replace soy. Its protein level is only just below that of soy and in combination with maize it is a protein-rich feed (for cows only). It is scooped out of the ditch and dried. In its dried form it is very reliable (tests showed no *Salmonella*, *E. coli* or botulism) and can be fed as meal or in cakes. An additional advantage of using duckweed in cow feed is that if it is harvested regularly, duckweed has a positive effect on water quality. Local governments may even be willing to pay farmers to harvest the weed. Although potentially very promising, the use of duckweed needs further research. For example, the issue of ownership, energy use and harvesting techniques need to be resolved.

7. Other options
By eating proteins, animals take in the amino acids they require. Adding free amino acids to wheat decreases the need for additional proteins like soy.

Potentially suitable non-Leguminsae (other than rapeseed) are quinoa and amaranth. Pilot studies have shown that amaranth is very successful for broilers. Experiences with quinoa have so far been less promising.

Finally, other potential substitutes for soy are milk proteins (especially suitable for young animals, but relatively expensive) and potato proteins.

Is it economically feasible to replace soy in animal feed?

An important bottleneck for replacing soy with the available alternatives is that animal feed compound is mainly optimized on the basis of price. Price is extremely important as animal feed is consumed in such large quantities and a small price difference can have major consequences. Current prices for alternative feed crops like peas and beans are too high compared with soy prices to make large-scale substitution possible without incentives from government or the private sector. However, the differences are not extremely high and will be reduced when soy prices rise in future. For example, Kamp et al. (2008) found that to replace between 38% and 49% of the soy meal currently used in compound feed, the price of peas would have to be 20% lower. To substitute between 52% and 75% of soy meal, a price reduction of 50% is needed. Recent calculation using computer models developed by a compound feed producer have shown that the extra costs of replacing soy with a variety of alternatives can be relatively small. Substituting all soy in compound feed for pigs resulted in a cost increase of 89 euro cents for 100 kg of compound feed. This would lead to a cost price increase of 5 cents per kg meat (which is

3.5%). In a calculation performed by Vahl (2009), the complete substitution of soy would even lower the cost price.

Is there enough land in the Netherlands or Europe to replace soy in animal feed?

The Netherlands produces large amounts of meat, dairy products and eggs. Of the total production of meat and eggs, roughly 70% is exported. The reason for this is that the location of factory farming in Europe is to a high degree determined by the availability of soy for animal feed and therefore the proximity to sea ports. The ports of Rotterdam and Amsterdam make the Netherlands a perfect location for factory farming based on imported soy.

On the other hand, the availability of arable land to produce local feedstuffs in the Netherlands is limited. If peas were to replace soy, all of the agricultural land in the Netherlands would be needed to grow them. Field beans need less land than soy, but replacing soy with beans would still mean that the total area currently used for wheat would have to be turned over to beans. A more realistic scenario, therefore, would be the cultivation of peas in North-Western Europe. If peas were grown in a crop rotation system once every five years, a total of 6.8 million hectares would be necessary to replace between 52% and 75% of soy in the total animal feed consumption of North-Western Europe. This is less than the total available acreage of 8.6 million hectares.

If South American soy were replaced by peas and lupines, less land would be needed (about 30%) if these crops were grown in the Netherlands, and the same amount of land would be needed if they were grown in North-Western Europe. [2] If soy were to be replaced mostly with rapeseed and wheat, the figures are less promising. The amount of arable land needed to replace all the soy used by the pig sector in the Netherlands would then be about 20% higher than for soy.

Private sector initiatives

Since October 2008, milk for Campina's Landliebe brand, the largest milk brand in Germany, has been produced without any soy input at all. Yoghurt, desserts and butter will follow in 2009. The Landliebe cows only eat "traditional crops" like grass and corn, supplemented with other crops that grow in Germany or Europe. No crops from "overseas" need to be imported, and it is guaranteed that the cows do not eat any GMO soy. Meat with the German Neuland quality label is also produced without the use of any imported feed; even the soy that is used is grown in Germany. In 2009 the Dutch compound feed producer Agerland and plant breeding company Limagrain started research to look into the possibilities of growing local crops like peas, beans and lupines to replace soy in animal feed. The UK company Abel and Cole recently introduced organic chicken meat that is produced without using soy-based animal feed. Although not yet a widespread phenomenon, some farmers have started producing their own animal feed and do not use any soy.

Public sector initiatives

One of the Dutch government's priorities for sustainability is "biodiversity, food and meat". Essentially, this means that the production and consumption of animal proteins is a priority, which opens up possibilities for replacing soy and introducing more integrated farm management systems. However, it is important to note that the European market for meat is highly integrated. Effective regulations for meat production and consumption and the stimulation of specific food stuffs can only be taken at the European level.

[2] Kamp et al. (2008) studied various sustainability effects of shifting protein production (i.e. production of peas and lupines) from South America to Europe, including the phosphate cycle, use of fossil energy and nitrate, and transport. Detailed results on the various sustainability effects can be found in this report.

The Dutch Soy Coalition

The Dutch Soy Coalition brings together Dutch civil society organizations working in the fields of nature, environment and development. The coalition was founded in response to alerts by partner organizations in South America about the negative impacts of soy production and expansion. The Netherlands plays a central role in the soy sector as the second largest importer from South America and central distribution point for Western Europe. Therefore, the members of the Coalition see it as their responsibility to raise awareness with consumers and the media, and ask our government and companies to take steps to reduce the negative impacts of soy production and trade. Concrete suggestions of steps to be taken by companies and the government can be found in our publication "Big business, big responsibility: Addressing the social and environmental impact of the soy value chain" and our mission statement, which is available through our website in English, Dutch, Spanish and Portuguese.

The factsheet and case study series has been developed to stress the urgency of the problems and the need to take action. They feature specific cases of social or environmental problems in particular soy producing countries. Should you wish to get in touch with the Dutch Soy Coalition or receive more background information on the issues, please contact the secretariat of the DSC at nsc@bothends.org or refer to our website www.sojacoalitie.nl. An overview of the sources used for this factsheet is available on the DSC website ('Links and Documents' section).