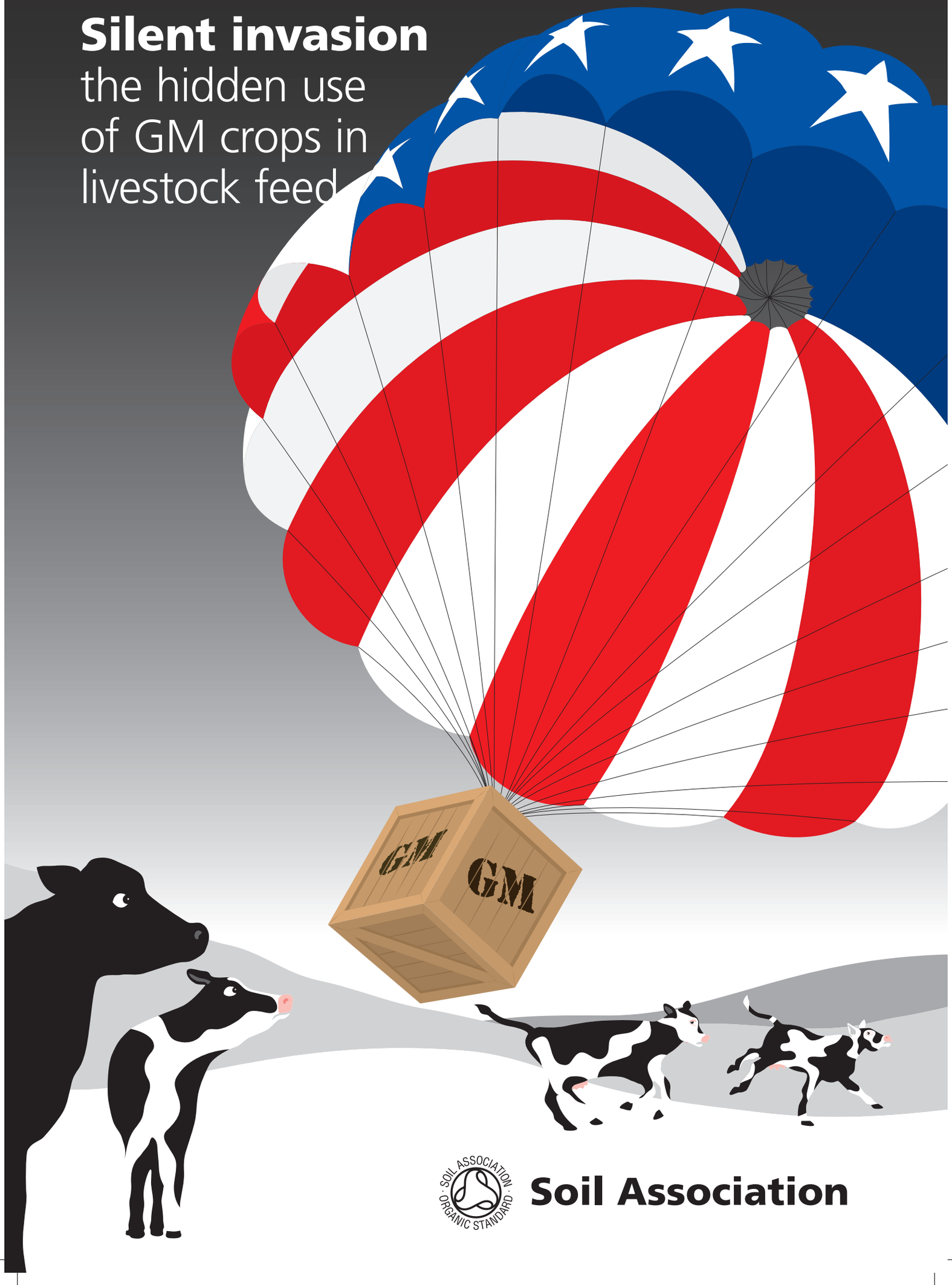
Silent invasion
the hidden use of GM crops in livestock feed



Soil Association

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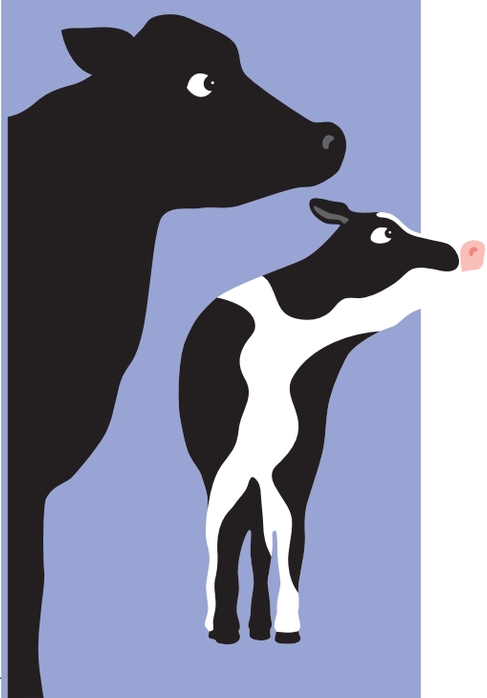


Executive summary

Key findings

- Nearly all the milk, dairy products, pork and red meat as well as many frozen and processed meat and dairy products sold in UK supermarkets are now being produced from animals fed on genetically modified (GM) crops and are being sold without GM labels.
- Fresh chicken, turkey and eggs, and beef and lamb from animals fed exclusively on grass, are the only livestock products in the supermarkets generally produced without GM animal feed, apart from organic food.
- Large volumes of GM crops are being imported into the UK as animal feed, including an estimated 146,000 tonnes of GM soya and 290,000 tonnes of GM maize, imported each year for the dairy, pig and poultry sectors. GM animal feed is probably also being used to produce much of the meat, dairy and egg products being imported into the UK.
- The market for GM animal feed is the main reason for the expansion of GM crops around the world and threatens the continued exclusion of GM ingredients from UK food.
- New scientific evidence shows that small quantities of GM material can end up in food produced from GM-fed animals, and that the use of GM feed can cause a range of negative impacts on animal health.
- The Soil Association believes that most members of the public are not aware that GM crops are being widely used to feed farm animals, and would be shocked to know that the supermarkets have been allowing this use of genetically modified organisms (GMOs) behind their backs.
- To be sure of avoiding products from GM-fed animals, **we recommend people buy their milk and meat from retailers that guarantee that their food is produced without GM feed, or buy organic food** which is always produced without GMOs. **Marks & Spencer are leading the way in this with their milk, eggs and fresh meat** all produced with non-GM feed (though not their frozen or processed foods).

Results of Soil Association investigation

Extent of GM feed

- The Soil Association undertook an investigation of animal feed (non-organic) around the UK: in 2006, we collected 37 samples of dairy, pig and poultry feed produced by a range of feed companies from 29 farmers and tested them for GM material. We also reviewed supermarket and feed company information, in particular to check the situation in the poultry sector.
- 89% of the animal feed samples that we checked contained GM ingredients, in line with Europe-wide industry estimates. The actual level of use of GM feed in the UK is lower than this, however, due to non-GM feed policies in the supermarket poultry sector, which we could not test adequately.
- Our tests revealed widespread and high use of **GM soya: 73% of all feed tested** contained some GM soya with 27% containing soya that was 70% or more GM (10 of the 37 samples). The soya in the dairy cattle feed was on average 51% GM (13 samples); the soya in our pig feed samples was 20% GM (16 samples); and in our poultry feed samples 37% GM (eight samples).
- Our findings indicate that, excluding feed for eggs and supermarket fresh poultrymeat, **around 30% of the soya in UK animal feed is GM**.
- We also conclude that **a very high proportion, perhaps around 60%, of the maize in UK animal feed is GM**; in particular, the dairy industry is widely using GM maize. This conclusion is based on the feed companies' information, rather than testing, for the reason that maize is mainly used in feed in a highly refined form, making it very difficult to identify in tests.

Dairy, pig and poultry

- The situation in **the dairy sector is of great concern** as, if our findings are accurate, most of the feed contains GM material. **The pig sector is also a concern** as, while the level of GM soya that we found was lower, soya makes up a higher proportion of pig feed. We did not investigate the red meat sectors, where the use of grain is lower. However, the lack of supermarket non-GM feed policies in these sectors means some GM feed is probably widely used, except for totally grass-fed animals.
- British poultry is the only sector where nearly all the supermarkets and the feed industry have made the effort to exclude the use of GM feed, which is very welcome. According to the industry information, **except for Iceland, all supermarket own-label fresh chicken and turkey, and Lloyd Maunder poultrymeat, are from non-GM fed animals.** However, GM feed is probably being used for producing much of the imported frozen and processed poultry products sold by supermarkets, other brands, independent retailers, restaurants and the catering trade.
- The situation in the egg sector is also fairly positive. Due to the supermarkets' requirements, an estimated around two-thirds of UK eggs are being produced with non-GM feed, including nearly all 'free-range' and 'barn' eggs and around half of caged eggs. **All of the major supermarkets require that all their own-label eggs are produced with non-GM feed, except for Iceland. The egg brands 'Woodland', 'Corn Gold', 'Columbus omega-3 rich', and 'Church and Manor' duck eggs, as well as all organic eggs, are also produced with non-GM feed.**
- The situation for eggs sold outside the major supermarkets is of some concern, however. There is no requirement for Lion Quality Eggs or even 'free-range' eggs to be produced from non-GM feed, and two of our four feed samples, which included samples from smaller producers, had high levels of GM soya. This means **non-organic eggs, including some 'free-range' eggs, sold by independent retailers may be produced with GM feed, unless labelled otherwise.** It also appears that **most of the caged eggs used in processing and catering are produced with GM feed.**
- Apart from the poultry sector, however, we found little action by the UK supermarkets to avoid GM feed, and most feed companies who provided information appear to be mainly buying soya and maize from the world commodity markets; only oilseed rape was of non-GM origin, for cost reasons.

Awareness and labelling

- None of the farmers who provided samples were intentionally using non-GM feed but we discovered a high level of ignorance among farmers about their use of GM feed. **At least 59% of livestock farmers do not know if their feed contains GM ingredients** (114 of 192), **despite the fact that our research found that three-quarters of animal feed is now labelled as GM.** This was disappointing as it is easy for farmers to check if the feed ingredients are labelled as GM.
- Our survey also revealed a **high level of breaches of the European GM labelling laws**, with seven of the 37 feeds, 19%, having a GM soya content well over the 0.9% threshold for labelling, without bearing a GM soya label; indeed five of these contained soya that was over 80% GM.
- Worryingly, the Food Standards Agency (FSA) who are responsible for enforcing the GM feed labelling legislation do not do any testing, despite admitting that GMOs are 'widely used' in UK animal feed. This may explain the high level of inaccurate and illegal labelling we uncovered.

Implications of the findings

- This use of GM animal feed is a concern. The industry and the FSA have been assuring the public that consumers would not be exposed to GM material by eating meat and dairy products from animals fed GM feed. Earlier studies did not detect GM DNA in meat, milk or eggs. However, new scientific studies have done so: two peer-reviewed studies have now detected GM DNA from GM feed in blood, liver, kidneys and intestinal tissue. In addition, a peer-reviewed study and an unpublished study have detected GM DNA in milk. Further research is needed, but it now seems the public is likely to be consuming GM material in foods from GM-fed animals, albeit in small quantities.
- The safety of using GMOs in food production is now of real concern as a growing number of published scientific studies are finding a range of serious health impacts from GMO consumption on animals. These include lesions in the gut, damage to body organs, unexplained deaths, and stunted growth in the young of animals reared on GMOs. This means that there are important animal health and welfare concerns over the use of GM feed; there are also concerns about possible long-term effects on people.

- The outbreak of the BSE epidemic ended the unpalatable practice of feeding cattle remains to naturally vegetarian cattle and alerted consumers to the practices of industrial livestock systems (part of the reason for the recent large growth in sales of organic food). Unfortunately, with the global growth in meat and dairy food consumption, the use of protein-rich crops, in particular soya and maize, expanded as a source of cheap protein in animal feed. The feed market for grain became even more important after the outlawing of cattle remains as feed, providing an even more significant commercial opening for GM crops in our food chain. This development is just as undesirable, unnatural and currently unknown to the public as the feeding of cattle remains to cattle was. It could also turn out to be a similar threat to animal and human health as BSE and the feeding of cattle remains.
- Currently the only general food label that guarantees the non-use of GM feed is 'organic'. Even ethical food labels like 'Freedom Foods' as well as the basic industry standards, the Little Red Tractor logo, allow the food to be produced with GMOs. In local markets or smaller retailers, even some 'free-range' eggs may have been produced with GM animal feed.
- Our investigation – both our findings and the various difficulties encountered – highlights the very serious lack of transparency shown by the supermarkets over the use of GM feed, and that the public currently has a very limited ability to make informed choices and influence the market in this area. This shows the great importance of extending EU labelling rules to cover foods from GM-fed animals, an option that is supported by most of the public.
- Securing the UK's future supply of non-GM soya feed is essential. Soya-based animal feed is not only used to produce most of our milk, meat and eggs but soya is also used in 60% of all processed foods. However, as animal feed is the most valuable use of soya, it is the feed industry that mainly determines the availability of non-GM soya.
- The key issue is that there is currently only one major exporter of non-GM soya: Brazil. Although there is more than enough Brazilian non-GM soya grown to supply the UK several times over at the moment, the proportion that is GM is increasing each year, as there is little incentive for the farmers to stay with non-GM varieties and GM varieties are being promoted by the biotechnology companies. The proportion of the traded volume that is effectively GM tends to go up faster than the percentage of the crop that is GM, as the GM and non-GM soya are usually mixed and traded together. The danger is that non-GM supplies will cease to be available in a few years, as happened in the US and Argentina, unless there are clear financial incentives for the traders to keep the GM and non-GM soya separate. Unless the UK feed and food industry starts specifically to demand non-GM soya for most of its supplies, the UK may lose the option of having non-GM soya for not just animal feed but also food use in future.

Recommendations

From these findings, the Soil Association urges the industry and public to take the following actions:

- Supermarkets, other food retailers and food manufacturers: to require and pay for all their meat and dairy suppliers to use only certified non-GM feeds by the middle of next year for all their fresh, frozen and processed meat and dairy foods; and meanwhile to label all their foods that are produced with GM feed so they are being honest with their customers.
- Those setting standards for food labels like 'Freedom Foods' and 'free range', basic industry marques like 'The Little Red Tractor' and 'Lion' eggs, and the largest food companies with the greatest power to determine the GM content of UK animal feed (like the major dairy companies and BQP, the largest pig producer) should insist on the use of only certified non-GM feeds and in the meantime be fully transparent about their feed policies in their communications.
- Farmers should check with their feed supplier if their feed is GM and order only certified non-GM feed, and where possible move to growing or sourcing UK-grown feed.
- Animal feed companies should from now on use only certified 'Identity Preserved'

non-GM soya, from 'sustainable soya' sources for all their feed; maize too should come from non-GM sources.

- All consumers who care about this should ask their supermarket, favourite food companies, restaurants and farmers' market to use only non-GM fed animals, and meanwhile buy only:

Milk – from Marks & Spencer, Sainsbury's 'Farm Promise' milk or organic milk

Eggs – any own-label supermarket eggs except from Iceland; the egg brands, 'Woodland, 'Corn Gold', 'Columbus omega-3 rich', and 'Church and Manor' duck eggs; for other brands and eggs in independent retailers, only eggs actually labelled as produced without GM feed; or organic eggs

Chicken and turkey – any supermarket own-label fresh meat except from Iceland; frozen own-label chicken in Sainsbury's and Morrisons; frozen own-label turkey in Morrisons; Lloyd Maunder products (in some supermarkets and butchers); or organic meat

Pork, beef and lamb – fresh meat from Marks & Spencer; beef- or pork-containing products in Sainsbury's Taste the Difference range; lamb or beef that is labelled as only fed on grass; or organic meat

Processed meat and dairy products – organic is the only known general non-GM option for processed meat and dairy products, such as yoghurt, cheese, butter, cream, ice cream, frozen meat, bacon, ham, sausages, meat pies, corned beef and ready meals.

Marks & Spencer is the only supermarket that sources all of its milk and fresh meat only from animals raised on non-GM feed; it also uses only 'free-range' eggs from non-GM fed chickens in its processed products. The Co-op, Sainsbury's and Waitrose offer a few non-organic meat and/or dairy items produced from non-GM feed, besides their own-label fresh chicken, turkey, eggs and farmed fish. Supermarkets which are offering few non-organic meat and dairy products from non-GM fed animals, besides their own-label fresh chicken, turkey, eggs and farmed fish, are: Tesco, Asda, Morrisons, Somerfield and Budgens. The only supermarket which does not offer any non-organic products from non-GM fed animals is Iceland.

1 Introduction

The hidden use of GM animal feed to produce our food has become the mainstay of the biotechnology industry in their efforts to introduce GM crops into Europe. Despite the successful public opposition to GM foods in the UK, unknown to the public, GM crops are now forming the basis on which much of our food from farm animals is produced, via animal feed. This subject has received little exposure so far. However, this massive use of GM crops in the UK has major consequences for the way our food is being produced now and in the future. This report is about the findings of a Soil Association investigation into the hidden use of GM animal feed in the UK.

For over a decade the use of GM crops for food production has been highly controversial and opposed by a majority of the British public. The introduction of GM food and crops has been promoted by a small number of powerful multi-national biotechnology companies, with the support of UK farm leaders and the US and UK Governments. For many years an intense debate raged about whether the cultivation and use of GM crops were in the long-term national interest or not.

As science and politics progressed, the public's views won out as regards GM foods. In August 1998, Government-funded research found that rats fed GM potatoes suffered negative effects. Although the findings were not accepted by the Government and scientific community at large, public opposition to the genetic modification of food was intensifying and, one after another, major supermarkets in the UK and in the rest of Europe adopted non-GM policies for the ingredients in their own-label products.[1] By October 2002, all of the main supermarkets in the UK had ceased stocking any foods with GM ingredients.[2] Meanwhile at EU level, compulsory GM food labelling legislation was adopted and all foods containing any known level of GM material or material derived from GM crops had to be labelled, enabling the public to avoid GM foods.

The introduction of GM crops into the British countryside was then halted because of scientific and regulatory developments. Concerns about the impacts of the agrochemicals that would be applied to GM crops on a wildlife population already greatly reduced by the previous set of agricultural technologies, were confirmed in a series of farm-scale trials. These were the largest trials ever carried out for evaluating environmental impacts.

At EU level, the voices of farmers who wanted to continue producing non-GM crops to supply the non-GM food market, and organic farmers concerned about contamination of their crops, were eventually heard by regulators. It was agreed that the uncontrolled introduction of GM crops would lead to widespread contamination of normal non-GM crops, with negative economic consequences on the farming industry and on the access of consumers to non-GM food. All European governments were therefore required to draw up plans to control GM crops. The introduction of GM crops has been halted while these are being drafted, and while there is no market for GM food.

However, while the public's wishes appear to have been listened to in respect of GM food ingredients and the cultivation of GM crops within the UK, a third front for the introduction of GM crops, the use of GM animal feed, has been overlooked. And this has been exploited by the biotechnology sector.

With the important exception of the UK poultry sector, the supermarkets did not follow through on their non-GM food policies and eliminate GMOs from the animal feed used to produce their meat and dairy products. The EU's GM food labelling laws do not cover foods from GM-fed animals, so there is no legal requirement to label meat, milk, eggs or other dairy products from GM-fed animals. So, whilst trumpeting their non-GM policies, the supermarkets are free to allow the use of GM feed by their suppliers, and the public has no easy way of knowing this when shopping for their meat and dairy products. Were the public aware of the extent of use of GM crops in the production of their foods, they would probably feel deceived by the supermarket claims that their foods are 'non-GM'.

When our supporters were informed about GM animal feed in 2005, the response was one of shock and concern. Hundreds of our supporters wrote to the supermarkets to ask that they use non-GM feed, in late 2005 and early 2006. We received copies of many of these letters, totalling around 800.

The exclusion of GM feed from the supermarkets' non-GM policies was a major

omission. The main GM crops in North America, Brazil and Argentina are being grown primarily for animal feed, with the food market being secondary. Although they have so far been prevented from being grown in the UK, they are being grown on a large scale in North and Latin America and being exported to the UK (and other countries) for feeding to livestock for producing much of our our milk, eggs, meat and other dairy products.

This use of imported GM animal feed is invisible. The crops cannot be seen in the countryside like GM crops being grown here would be, and they are not being used and labelled as direct ingredients in our food. Nevertheless, UK farm animals are being regularly fed GM crops, and a very large proportion of our food from farm animals is being produced with the substantial use of GMOs. The use of GM animal feed for imported meat and dairy products is just as invisible as in UK-produced food, and even harder to address.

The fact that the animal feed industry is using GM soya also has serious consequences for the maintenance of the supermarkets' non-GM food policies. The fates of non-GM crops in the feed and food sectors lie together. Soya is widely used in food: it is contained in 60% of processed foods, such as margarine, chocolate, bread, cheese, cakes, biscuits, noodles, baby food, sausages and breakfast cereals. However, the majority of soya protein is used in animal feed, not human food, and this is the single most valuable use of soya.[3] So it is actually the animal feed industry which mainly determines whether farmers grow GM or non-GM soya, and so whether there continue to be adequate non-GM soya supplies available for our food.

The problem is that the security of the supply of non-GM soya is now under threat. Currently, more and more GM soya is being grown in Brazil, the country that is our main source of non-GM soya. The two other leading world exporters of soya, the US and Argentina, already have a predominantly GM soya crop. Unless the expansion of GM soya in Brazil is stopped, non-GM soya may eventually no longer be available in sufficient quantities for all our food, let alone for our animal feed. Currently, there are more than adequate supplies of non-GM soya. But for this to continue depends on the supermarkets and food companies insisting on non-GM feed. If the animal feed industry requires the use of non-GM soya, non-GM soya will continue to be grown. This in turn depends on the public insisting on non-GM feed for the production of their foods. If the supermarkets and food companies insist that all the meat, milk and eggs they sell comes from animals raised on non-GM feeds, and pay the feed companies the small premium required, then a guaranteed market for Brazilian farmers for non-GM soya would be created, and continued supplies assured for UK consumers.

Something else has changed in the last couple of years which now makes this issue far more urgent and important. The debate on the safety of GM crops has now moved on. There is now a body of scientific evidence on the safety of GM crops, including GM soya, which was not available when GM crops were first being marketed. Perhaps contrary even to the expectations of many of those opposed to GM crops, the evidence is showing a range of unexpected adverse impacts from consuming GM crops. Several published scientific studies have now found serious negative impacts on animal health, such as lesions in the gut, damage to body organs, unexplained deaths and stunted growth in the progeny of animals reared on GMOs. This means that there are important animal health and welfare concerns, as well as concerns about long-term health impacts on humans, that are raised by the use of GM feed. It appears that the science is turning out strongly on the side of the public who had, intuitively, opposed GM crops. It is therefore all the more urgent that the use of GM feed is stopped, and non-GM food and feed supplies are secured.

With these major concerns in mind, it was important to determine the current use of GM feed in the country. This would allow us to inform the public of the extent to which the UK is using GMOs in the food chain and supporting the expansion of GM crops abroad.

2 Context – UK animal feed market

How GMOs came to be used to produce our meat and dairy foods

With other avenues closed, GM crops have found their only route into our food chain via the animal feed industry. This was made possible due to the fact that GMOs can be legally used in this way without the public having to know, as the products are not labelled. The importance of this market for GM crops has been boosted by the large expansion in the global use of animal feed due mainly to the global growth in meat and dairy consumption, but also, strangely, by the consequences of the BSE crisis.

Worldwide, people are eating more and more animal products than ever before. The consumption of meat, eggs, milk and other dairy products has undergone huge growth in recent decades: between 1961 and 2000, global meat production increased three-fold (from 70 million tonnes to 233 million tonnes).[1] These enormous increases have been achieved through the intensification of livestock production, greatly reducing the cost and increasing the quantity of animal products consumed. This has been managed through faster growth rates (for example, an intensively farmed chicken now reaches slaughter weight in just six weeks, which is twice as fast as 30 years ago) and by pushing animals to their physical limits (many cows are now made to produce over 10,000 litres of milk per year compared to traditional yields of around 5,000 litres per year). These changes were enabled by developing fast-growing, high-yielding breeds and using management methods that promote unnaturally high levels of growth and production. At the base of all this has been the adoption of intensive feeding regimes using high-energy and protein feeds.

This intensification and expansion of the livestock industry has thus required a huge and still-increasing supply of animal feed, in particular protein-rich ingredients. This has particularly boosted the market for soya, which has long been a major component of animal feed and is both plentiful and affordable. Native European protein-rich legumes, such as peas and beans, have long been grown (and subsidised) throughout Europe, but they did not play a major role in the growing animal feed trade.

Worldwide, the dominant source of protein for animal feed is now oilseed meals, accounting for over 90% of the total by weight, with meat and bonemeal and fishmeal accounting for most of the rest.[2] Soya is by far the most widely used of the oilseed crops, accounting for 61%, by weight, of the oilseed crops used in animal feed.[3] This is because soya meal has a particularly high protein content, and the protein is of higher quality than that of many other crops.

The fact that the European protein deficit was filled by imported crops is partly due to a longstanding European Union agreement with the US. In the 1960s, the EU Common Agricultural Policy was built upon an understanding that Europe would focus on cereal crops and the US on protein crops. Europe imposed tariffs on the importation of cereals, milk, beef and sugar, but no equivalent tariffs were imposed on imports of animal feed. An agreement signed with the US in 1992, the Blair House Agreement, confirmed this deal: Europe agreed to limit the area of subsidised plantings of oilseeds (mainly oilseed rape, sunflower seed and soya). Europe was left with a large shortage of cheap protein feed which was met by imports.[4,5] A few years later, and soon after the introduction of GM varieties in 1996, the US Government introduced heavy subsidies for soya and maize production.[6,7] As a result, Europe's intensive livestock industry has been heavily dependent on imported animal feed to this day.

The BSE crisis further boosted the use of soya. Unknown to consumers, until 1996, another cheap source of protein had been 'meat and bonemeal' – the remains of dead cattle. After the outbreak of BSE in cattle and of the human version of the disease, nvCJD, suspicions fell on this previously hidden practice. The Government banned the feeding of meat and bonemeal to cattle in April 1996,[8] followed several years later by a Europe-wide ban. Interestingly, the 1996 UK meat and bonemeal ban came just as GM soya was being commercialised. The day before, the European Commission gave permission for the importation of Monsanto's Roundup Ready soya (which was genetically modified to be resistant to Monsanto's herbicide, Roundup). Imports of GM maize and GM oilseed rape were authorised the following year.[9]

So while the BSE scandal ended the unnatural and unpalatable practice of feeding cattle remains to naturally vegetarian cattle and awakening consumers to the practices of industrial livestock systems

(part of the reason for the recent growth in sales of organic food), it helped boost the one significant commercial opening for GM crops in our foodchain, as animal feed. This is something that is just as undesirable, unnatural and currently unknown to the public as the feeding of cattle remains to cows was at the time. It could also turn out to be a similar threat to animal and human health as BSE and the feeding of cattle remains.

The role of labelling rules in the use of GM feed

Up until April 2004, there was no legal requirement for animal feed containing GM ingredients to be labelled as such. This contributed to the low awareness of GM ingredients in animal feed and the growth of their use, as most farmers simply could not know whether or not their feed was GM. This significance of GM feed labelling is indicated by research carried out by ADAS in spring 2004: a survey of almost 1,700 non-organic farmers found that only 26% would consider feeding GM products to their stock.[10]

This was in contrast to the situation with human food, where GM labelling was required throughout Europe for all GM ingredients, enabling supermarkets and consumers to have the choice of avoiding GM foods. By October 2002, the British Retail Consortium, which represents all of the major supermarkets, had said they would no longer stock any foods or ingredients which were genetically modified, in response to the demands of their customers.[11]

In April 2004, strict EU feed labelling regulations came into force which required that the ingredients list of animal feeds state if an ingredient is from a GM crop. Under the legislation, if any amount of the ingredients is known to be GM or not from a known non-GM source, the feed must be labelled as GM. The only exception to this requirement is if the feed producer uses a non-GM source but GM material up to 0.9% of any ingredient is found to be present due to "adventitious or technically unavoidable" contamination. This allows for unknown, accidental, low-level contamination.[12]

But perhaps the most important factor which enabled GM ingredients to be used to produce so much of our food without the public's awareness, is the fact that the milk, eggs, meat and other dairy foods produced from GM-fed animals do not need to be labelled as produced with GMOs. As a result, consumers have been wrongly led to assume by the supermarkets' highly publicised non-GM statements that GMOs have been removed from the whole food chain. Importantly, consumers have also had almost no way of knowingly avoiding such animal products, unless they chose to buy organic produce (where the animals are always fed a non-GM diet, in accordance with organic principles and standards).

Consumer opposition to GM is strong and increasing: an Europen Commission survey in 2005 throughout the EU found that 58% of consumers are opposed to GMOs and only 27% believed that GM foods should be supported.[13] In all of the 15 EU countries which had participated in the four surveys carried out since 1996, the level of support or tolerance for GM crops had fallen since 1996. There is particularly strong demand for labelling foods from GM-fed animals: an NOP survey in 2006 found that 87% of the UK public believe such foods should be labelled,[14] up from a finding of 79% by the National Consumer Council in 2001.[15] A European-wide petition for such labelling collected a million signatures by February 2007.[16]

The GMOs used in animal feed

The UK feed market is made up of feed produced by the feed manufacturing companies, feed produced by the integrators, and the 'home-mixing' market. Home-mixing refers to farmers producing their own feed either from their own feed crops or from bought-in 'straight' feed ingredients. In total, UK agriculture uses 21–22 million tonnes of purchased feed each year, just under half of which is compound feed produced by the feed manufacturing companies, and the rest is feed ingredients bought by the poultry integrators and for home-mixing.[17]

Manufactured feeds include those termed 'concentrates' – high-energy or protein crop substances – and 'compound' feeds – mixtures of raw ingredients made to specific formulations for different livestock. The cattle, poultry and pig sectors are the main users of compound feed in the UK, with the dairy sector accounting for 40% of the total in 2005, poultry for 37%, and pigs for 15%.[18] Some but not all beef cattle will receive some concentrates.

Three different GM crops have been licensed for use in animal feed in the EU: soya, maize and oilseed rape. GM soya and oilseed rape are only licensed for importation, but GM maize can also be grown in the EU (although there are only significant areas of production in Spain and France, with smaller areas in the Czech Republic, Portugal and Germany [19]).

According to the European feed industry, about 90% of compound feeds produced in Europe contain some GM soya.[20] It was not known, however, if this figure applied equally to the UK, what proportion of feed is GM, and how this compares among the sectors.

(i) Soya

Soya is used for both human and animal consumption. Soya beans are processed into soya protein, soya oil and soya lecithin. The soya protein makes up about 80% of the soya bean, and nearly all of this is used in animal feed. The other two products of the bean are used for human food.

Some human foods such as soy sauce, soya milk or tofu, obviously contain soya. However, many other processed foods contain ingredients derived from soya. The main soya product used in human food is the oil. This can be used directly as vegetable oil but is commonly modified by an industrial process known as 'hydrogenation' and used in various processed foods such as margarine and commercial frying fats. Soya lecithin is also used in a wide variety of foods such as chocolate, dairy products and bread.[21,22]

Because of the relatively low oil yield from soya beans and because of the very high levels and high quality of the protein in the meal, soya is unlike other oilseed crops, such as oilseed rape or linseed, in that it is grown mainly for its meal. The meal, which is used in animal feed, represents 60–70% of the value of the bean.[23,24,25]

Within the EU, around 95% of total soya protein is used in animal feed in the form of soya meal. Soya meal has a very high protein content, at over 44%.[26,27] By weight, soya meal accounts for about 54% of all the protein-rich feed material used in European animal feed: consumption of soya meal in 2003/2004 was 32.6 million tonnes out of 60.5mt of protein-feed material.[26] Because its protein content is higher than that of other feed materials, soya meal accounts for 67% of the protein contained in protein-rich feed materials in the EU.[26] The EU is the largest single soya importer (of both soya beans and soya meal), although there has been large growth in Chinese imports in recent years.[28,29]

Data on the composition of British animal feed are no longer collected by sector, but government data from the early and mid-1990s show that soya meal could make up to 20–23% of a compound feed fed to broilers (chickens reared for meat), about 10–13% for egg-laying birds, around 18–24% for pigs and about 2–7% for dairy cows.[30] This would give an average soya inclusion rate of around 15%. Defra, however, says that the overall soya inclusion rate for all feed produced in the UK is now 11% (including straights, blends and home-mixing),[31] although this may not include feed used by the poultry integrators. This was confirmed by BOCM Pauls who say that levels of soya have fallen and the average is now around 11–12%.[32]

In 2005, the UK imported approximately 1.8mt of soya beans and soya meal.[26] This is a small fraction of the amount produced globally, around 236mt, half of which is traded internationally. The world's three main producers of soya are the United States, Brazil and Argentina (see first table overleaf). In 2006/07, the US produced 37% of world production (87mt), Brazil produced 25% (59mt) and Argentina 20% (47mt).

About half of the quantity of soya produced is exported to other countries, 115mt. In 2005/2006, Brazil and the US were the world's largest soya bean exporters, as the third table overleaf shows. Large quantities of soya are also exported as soya meal, of which the world's largest exporter is Argentina (see last table overleaf).

Global expansion of GM soya production

It is estimated that in 2007, over 99% of Argentinian soya, 91% of US soya and at least 45% of Brazilian soya is GM (see table overleaf). Together this means that up to 69% of the soya beans and meal traded internationally is GM, with at least 38mt being traded that is non-GM[33] (the non-GM amount will be more than this if a higher proportion of the exported soya is non-GM than the soya used domestically). However, only part of this is currently segregated so the proportion of the traded amounts that contain GM material is far higher.

Although the US still produces a significant quantity of non-GM soya (over 9mt annually,[34] enough to supply the total UK soya bean and meal imports five times over), this is currently not generally segregated from the GM supplies, so almost all US soya is considered as GM. Despite the large potential market for non-GM soya in Europe, the limited use of segregration in the US can be explained by the commercial alliances between the biotechnology companies and the large soya companies, Cargill and ADM, and by the infrastructure used to store and transport soya. These companies own most

of the storage, transport and processing facilities and control over 50% of the world soya feed trade. According to the National Farmers' Union,[35] "The soya market is … characterised by the interaction with the biotechnology market. In 1999, Monsanto … started a joint venture with Cargill to develop genetically modified (GM) seeds for animal feed. ADM has similar strategic alliances with Novartis/AstraZeneca and Dupont/Pioneer. Grain traders push the products of their strategic partners. As a result, GM soya … is consistently increasingly its share of the market" at the expense of non-GM soya.

In contrast to Argentina and the US, Brazil is a highly valuable soya producer as it is the only major exporter that provides significant quantities of non-GM soya. The proportion of soya production in Brazil that is GM is now 45–50%, up from 30–35% in 2006.[36] This means that around 30mt is non-GM, 16 times as much soya as the UK imports. This increase is a concern, particularly as the proportion of the traded volume that is effectively GM tends to go up faster than the actual percentage of the crop that is GM, as some of the GM and non-GM soya is mixed and traded together. The major concern is that in the coming years, without a clear and significant market demand for non-GM soya and segregation in the supply chain, much of the rest of Brazilian production could continue to follow the US and Argentina and become largely GM. Then, the world's only major supplier of non-GM soya may no longer be a sufficient or reliable source of non-GM soya.

Apart from Brazil, India is also a significant producer of non-GM soya, producing around 10 million tonnes per year, though it is not currently considered a reliable international supplier.[38] China also produces non-GM soya as the cultivation of GM soya is not permitted, but it is a net-importer of soya and so not in a position to supply Europe. Non-GM soya is also grown in small quantities in some other countries, such as Bolivia, South Africa and Australia.[38]

There is no lack of availability of non-GM soya supplies and there are now several Brazilian soya companies supplying certified non-GM soya to Europe (such as IMCOPA, Caramuru, AMaggi and BREJEIRO). For example, in 2006, Cert ID, a company which independently certifies non-GM soya for some of the non-GM soya suppliers, said that it had certified and had available to certify, a total of 11 million tonnes of non-GM Brazilian or Bolivian soya beans or soya meal.[39] This is six times as much as the UK needs.

(ii) Maize

Maize is widely used as an energy source by the animal feed industry, mostly in the form of a refined derivative, maize gluten. Although its protein content of 21% is half that of soya (at over 44%), it is also an important source of protein. Recent figures are not available but government statistics from the early to mid-1990s show that maize gluten made up around 15% of the compound feed for dairy cows, around 2–4% of the compound feed for growing and finishing pigs, while compound feed for egg-laying birds and broilers did not contain any.[30]

Globally, the main use of maize is for feed, but like soya it is also important in the food sector[40] and the two uses are connected. For example, wet-milling is an important use of maize grain in the US. The process separates the kernels into its constituent parts, producing starch, gluten, maize gluten feed and germ. The

World production of soya

Soya production, millions of tonnes

	02/03	03/04	04/05	05/06	06/07*
US	75.0	66.8	85.0	83.4	86.8
Brazil	52.0	51.0	53.0	57.0	59.0
Argentina	35.5	33.0	39.0	40.5	47.2
China	16.5	15.4	17.4	16.4	16.2
Other	18.0	20.4	21.3	23.3	26.9
Total	197.0	186.5	215.7	220.1	236.0

*Source: USDA[28] (*USDA estimate made in May 2007)*

Percentage of soya bean production in major producers which is GM (%)

	2001	2002	2003	2004	2005	2006	2007
US	68	75	81	85	87	89	91
Argentina	97.3	99	99.1	99.3	99.5	99.5	99.5
Brazil	8–10	8–10	8–10	12–18	20–25	30–35	45–50

Source: USDA for US (2001–2006; for 2007, minimum SA assumption); American Soybean Association for Argentina (2001–2006; for 2007, minimum SA assumption); IMCOPA for Brazil.[37]

starch is further converted into refined products for the food processing industry, mainly high fructose syrup but also glucose syrup, dextrose, corn syrup solids and maltodextrins, as well as starch products for paper industry. Maize gluten for feed use is a by-product of the wet-milling process.[40,41]

Around 69% of maize gluten used in European animal feed is imported from outside the EU.[26] Worldwide it is estimated that the vast majority of maize is non-GM, with only around 15% being GM.[19] However, currently most maize gluten imported into the EU comes from the US, a major global maize exporter. This is virtually all from GM sources, because of the very high proportion of US maize production that is GM, 61% in 2006,[42] and also because maize gluten is sourced from the wet-millers, who are generally using the unsegregated (mostly GM) part of the US maize supply.[43] This means that probably over 90% of US maize gluten is GM.[43]

A survey carried out in 2004 showed that 24% of US maize grain elevators segregate their GM and non-GM deliveries and half of these pay premiums to the non-GM farmers (ranging from $0.05 to $0.3 per bushel).[44] This indicates that the segregated non-GM maize is often or usually sold at a higher price to buyers who specifically want non-GM maize. We have no information on where the segregated, non-GM portion is going. Perhaps part is going into the US food sector, perhaps part is exported for food in other countries. Nevertheless, it follows that the average GM level in the remaining US maize is higher than 61%, and that the majority will contain some GM.

The UK imported around 900,000 tonnes of maize gluten from the US in 2005 [45], though the level apparently fell to around 250,000 tonnes in 2006.[46] There are also some UK maize processing plants that use imported grain.

(iii) Oilseed rape

Oilseed rape is used in feed for its meal and oil. It also widely used in the food industry, for example, to produce hydrogenated fats.

Most of oilseed rape used in Europe is non-GM. Unlike soya and maize, which do not grow so well in northern Europe, oilseed rape grows easily in the EU and large quantities are grown, almost sufficient for the needs of the feed industry. According to the European Feed Manufacturers' Association (FEFAC), the amount of oilseed rape that Europe produces is sufficient to supply 93% of that used in European animal feed.[26] European-grown oilseed rape is all non-GM and generally cheaper than imported North American GM oilseed rape.

Worldwide, it is estimated that 80% of the oilseed rape grown in the world is non-GM.[45] In Canada, however, GM varieties now account for a majority of their crop. Large quantities of rape used to be imported into Europe from Canada until the mid-1990s, but this C$300–400 million worth of annual trade almost completely disappeared immediately after the introduction of GM rape varieties in Canada in 1996.[47] This collapse in trade appeared to be due to the lack of a market for GM varieties but may also be due to increasing transport costs. In 2005–06, no unprocessed rape was being imported from Canada, although 245,000 tonnes of rapeseed oil was imported into Europe from Canada,[48] which would be nearly all GM.

In 2006, the UK produced 1,870,000t of oilseed rape. It exported 207,000t and imported 123,000t from the EU (none from the rest of the world).[49] So UK imports account for only 7% of total UK oilseed rape use. While some GM oilseed rape may be included in UK animal feed via this imported portion, the amounts must be very small.

World soya bean exports

Soya exports, millions of tonnes

	02/03	03/04	04/05	05/06	06/07*
US	28.4	24.1	29.9	25.6	30.3
Brazil	19.7	20.4	20.1	25.9	24.1
Argentina	8.7	6.7	9.6	7.3	7.7
Other	4.3	4.9	5.2	5.2	8.2
Total	61.2	56.2	64.7	64.0	70.3

*Source: USDA[28] (*USDA estimate made in May 2007)*

World soya meal exports

Soya meal exports, millions of tonnes

	02/03	03/04	04/05	05/06	06/07*
Argentina	18.3	19.2	20.7	24.2	25.2
Brazil	13.6	14.8	14.3	12.9	12.7
US	5.7	4.7	6.7	7.3	7.8
Other	4.8	6.9	5.0	7.0	7.3
Total	42.4	45.6	46.6	51.4	53.0

*Source: USDA[29] (*USDA estimate made in May 2007)*

(iv) Cottonseed

Very small amounts of cottonseed meal or extract is used by the UK feed industry, but this seems unlikely to be GM. Although a large proportion of the cotton grown outside Europe is GM, Europe is more than self-sufficient in cottonseed (producing 113% of its needs).[26]

The main UK feed manufacturing companies

BOCM Pauls is the largest feed compounding company in the UK, and an important feed producer for the pig, poultry and dairy sectors. The second largest company is ABNA, who own ABN and KW Alternative Feeds: they are more significant feed producers for pigs and poultry than for ruminants. For dairy cattle, Carrs Billington are large feed producers; NWF and Mole Valley Farmers are also important.

For pigs and poultry, apart from ABNA and BOCM Pauls, the main feed producers are companies called 'integrators'. These are agricultural companies that own and manage more than one stage of the industrial production chain, usually through production contracts with a large number of farmers. They may have their own feedmills so they can produce their own compound feed and may also produce the chicks/piglets to supply the farmers.

Grampian chickens, the UK's largest poultrymeat producer,[50] is a fully integrated business (and part of the Grampian Country Food Group which owns a number of other pig and poultry food brands). It supplies supermarket own-label poultrymeat to the main supermarkets,[50] including Tesco, Sainsbury's, Asda, Marks & Spencer and Morrisons.[51] Grampian owns the 'grandparent flock' (which lays the 'laying flock'), the laying flock (which lays the eggs that produce the chicks for meat), eight hatcheries (where the eggs are hatched), their own growing farms where the chicks are reared into chickens for slaughter, and a chicken processing unit. The Grampian food group also produces pork on a mixture of company-owned farms and by contract with farmers. The company produces 1 million tonnes of compound feed for pigs and chickens, from their five feed mills and one extrusion plant in the UK.[52]

Another poultry integrator is Bernard Matthews which produces 7 million turkeys on 56 farms in East Anglia and Lincolnshire,[53] as well as birds on its farms in Eastern Europe.[54] The birds are fed from the company's own feed mill.[53]

A smaller but still significant poultrymeat integrator is Lloyd Maunder, which produces both non-organic meat (including 'free-range' and 'Freedom Foods' chickens) and organic chickens. It supplies chicken and processed chicken products for supermarkets, butchers shops, wholesalers and caterers. The company produces its own day-old chicks and has its own feedmill, to supply the farms which produce its birds.[55]

The main UK egg supplying company, Noble Foods (from the merged Deans Foods and Stonegate) is also a major feed producer.

The poultry industry's non-GM feed commitments

Since 2001, the poultry industry has made strong public claims that UK chickens are given non-GM feed. In February 2001, Grampian chickens announced that it would be removing all GM ingredients from its feed by June 2001.[56] Bernard Matthews also apparently said it was using non-GM feed for its turkeys in 2001.[57]

The UK egg industry has made similar statements. In 2001, Richard Kempsey of the British Free Range Egg Producers Association (BFREPA) stated, "All free-range producers producing for the Lion egg scheme (BEIC) and Freedom Food schemes are using non-GM sourced soya and oil. Additionally all the major retailers are also moving to IP sourced soya most from 1 June this year." [58]

As the poultry industry is an important food sector and a major user of compound feed, we wished to confirm the current situation and so tried to verify these claims in our research.

3 GMOs in UK animal feed

3.1 Soil Association feed testing programme, 2006

Survey methodology

We collected a wide range of samples of animal feed used in the UK non-organic dairy, pig and poultry industries, and tested them for the presence of GMOs. We did not test feed from the beef and sheep sectors, where there would also be some use of GM feed, albeit at much lower levels. We also directly contacted the feed companies and supermarkets and asked about their GM policies.

We first identified the main feed companies in each of the three sectors. We then contacted farmers, mostly from the Yellow Pages, to see if they would be willing to provide samples. Farmers who agreed were given containers, written instructions on how to collect approximately 1kg samples, and money for postage. In most cases, the samples were collected by the farmers themselves and sent to the Soil Association by post; in some cases they were collected by the Soil Association. We did not collect samples from some who agreed to provide samples but who were organic farmers, very small producers, or only kept sheep or beef cattle. Some pig and poultry farms were using a variety of feeds and supplied us with more than one sample. Approximately 400g of each of the samples were then sent on to a specialist testing company, Genetic ID, whose laboratory is in Germany. Information on the feed company, the GM labelling of the feed, and the farmer's awareness of their use of GM feed was also collected.

289 non-organic farmers were contacted in total, from which 37 samples were collected from 29 farms. We took care to ensure that the samples came from various regions throughout England, Scotland, Wales and Northern Ireland, and from all the main feed companies.

The samples were tested for the presence and proportion of GM soya, maize and rapeseed. For soya, the limit of detection (the minimum percentage of GM material for GM presence to be reliably identified) was 0.01%. The level at which it was possible to quantify the proportion that was GM was higher, generally 0.1% (this varies, depending on the amount of soya present in the sample). The margin of error was generally +/-40% (so, for example, a result of 2% GM would actually mean a level of between 1.2% and 2.8% GM). This should not affect our overall findings on the use of GM feed, as we did not wish to determine the exact level of GM material in each specific case, but rather to investigate the general level and extent of GM use in the different sectors.

Because maize is usually included in animal feed in the form of the refined derivative maize gluten which has very little or no DNA left in it, determining whether maize gluten is of GM origin or not by testing is very difficult. Oilseed rape is also often used in a highly refined form, as oil, so GM rape is also hard to identify. Therefore, for maize and oilseed rape, as well as the test results, we also used the information from the feed labels and the information provided by the companies to assess the extent of use of GMOs.

Overall, our dairy cattle feed results should be representative of the industry, as 13 samples were collected from 13 farms and all the major feed companies were covered. Our results for pigs should be fairly representative as 16 samples were collected from nine farms, including from large intensive farms and from the two main feed companies for this sector (BOCM Pauls and ABNA). We did not obtain samples from the pig integrators, but our information from the supermarkets indicates they are unlikely to have different feed policies from the rest of the industry.

For the poultry sector, however, which covers eggs, chicken meat, turkeys, ducks and geese, our sampling was very limited, with only four samples from poultrymeat producers and four from egg producers, some of which were smaller producers. Although we covered the two main feed companies for this sector (BOCM Pauls and ABNA), we were, importantly, unable to obtain samples from the poultry integrators and three of our four poultrymeat samples were from two turkey producers. So our sampling was not at all representative of chicken in the supermarkets. For eggs, we were informed that around 95% of 'free-range' and 'barn' eggs produced in the UK should be subject to the policies of the supermarkets, even if they are not eventually sold to the supermarkets.[1] This suggested

Sector results

Dairy

- GM soya and GM maize both widely used, with 51% of the soya being GM on average (10 of 13 samples contained soya) and around 50% of the maize assumed to be GM.
- 11 of the 13 samples had GM labelled ingredients.
- 4 samples contained 100% GM soya, two of which were not labelled as containing GM soya.
- 9 samples were labelled as containing GM maize, but our tests could not identify any GM maize.

Pigs

- GM soya was widely used and 20% of the soya was GM an average (13 of 16 samples contained soya).
- 12 of the 16 samples had GM labelled ingredients.
- 1 sample contained 100% GM soya and another 96% GM soya; neither were GM labelled.
- 8 samples were labelled as containing "GM vegetable oils" which may have been largely soya oil.

Poultry

- 7 of the 8 samples contained GM soya with an average of 37% of the soya being GM.
- 4 of 7 samples had GM labelled ingredients (we did not obtain one ingredients list).
- 2 of 4 feeds for layers had significant amounts of GM soya (32% and 70% GM).
- The one broiler (chicken meat) sample, from ABN, contained 100% GM soya; 2 of the 3 turkey feeds contained high levels of GM soya (14% and 81%).
- 1 sample contained soya which was guaranteed non-GM (and confirmed by our testing).

that our egg feed samples, if they were for 'free-range' or 'barn' eggs, might be more representative of eggs in the supermarkets than our poultrymeat sampling. Nevertheless, we only managed to collect four samples from the egg sector. We have therefore relied mostly on industry information to ascertain the use of GM feed in the egg and poultrymeat sectors.

Survey results – GM presence

10% of the non-organic farmers who we contacted agreed to provide feed samples (29 of 289 non-organic farms), a reasonable success rate, comparable to typical response levels for questionnaires. The main reasons given for refusing to supply feeds were: that the farmer felt we should collect the samples direct from the feed companies; that they were too busy or didn't think they would benefit by participating; that they no longer kept animals; that they did not want to affect their good relationship with their feed supplier; or that they don't want to upset the supermarkets who are their customers.

It was disappointing that among those who were least ready to be open about their use of GMOs or to having their claims verified were the largest, most intensive meat producers. Some pig farmers producing on contract and British Quality Pork (BQP), the largest pig production company operating on over 250 farms,[2] did not wish to provide samples. Grampian, the main poultrymeat producer, also refused, saying their feed is non-GM and that they do their own testing.

The breakdown of the 37 feed samples is:

- by sector: the 37 feed samples comprised 13 dairy feed samples collected from 13 dairy farms, 16 pig feed samples from 9 farms, and 8 poultry samples from 7 farms (4 egg and 4 poultrymeat producers)
- by company: the 37 samples included 13 samples of BOCM Pauls feed, 6 of ABN feed, 3 of Carrs Billington feed, and 2 of Mole Valley Farmers feed
- most were samples of compound feed, but 4 of the feeds were labelled as containing pure soya.

The key results of the GM tests were:

- overall, 89% of the feeds were 'GM' (containing GM soya or with other labelled GM ingredients); 4 feeds were non-GM, containing neither GM soya nor having other GM labelled ingredients
- 27 of the 37 samples (73%) contained some GM soya (above 0.1%)
- 10 of the 37 samples (27%) contained soya that was 70% or more GM
- 16 of the 37 samples (43%) contained soya that was less than 1.5% GM or not GM
- overall for all three sectors, on average 35% of the soya in our feed samples was GM
- the dairy feed samples had the highest percentage of GM soya, with 51% of the soya being GM
- 77% of the feeds sampled (27 of 35) had GM labelled ingredients (mostly GM soya, GM 'vegetable oil' and GM maize)
- no GM maize was identified by testing, but 9 of the 13 dairy samples were labelled as containing 'GM maize'
- no GM oilseed rape was identified.

A table summarising the GM test results for soya is presented on the next page. For the detailed results, see Appendix I. Note, we have not reported as GM any results that were below 0.1% GM, to take account of the small possibility of accidental contamination of the samples and because such amounts are anyway insignificant in terms of the market for GM crops and the application of the GM labelling legislation.

77% of the feeds that we sampled had GM labelled ingredients, 27 of 35 feeds (we are excluding two samples, as we did not obtain the ingredients list from the farmer for one sample and one was illegible by the time we received it). These 27 feeds were mostly labelled for GM soya (19 samples, all sectors), GM vegetable oil (11 samples, eight of which were pig feed) and GM maize (nine samples, all dairy feed) (the exact wording varied). One pig feed contained GM labelled rapeseed. Almost half the feeds had two GM labelled ingredients. We think the vegetable oil is likely to be a mixture of vegetable oils but particularly soya oil, as 'soya oil' was included in several ingredients lists. In total, one dairy feed, three pig feeds and three poultry feeds had no GM labelled ingredients on the ingredients list, while another feed was supplied by the company without any ingredients list, making eight feeds in total that had no GM label. The absence of a GM label was not, however, a reliable indication of the absence of GM material – see below.

Of 36 samples (excluding the one which had an illegible ingredients list), we consider 32 samples as effectively 'GM' (89%) on the grounds that they either contained GM soya (27 samples) or had other GM labelled ingredients (also 27 samples). Only four samples could be considered as 'non-GM' (11%). One feed sample, from a turkey farmer, was guaranteed non-GM feed. This was indicated by the fact that the ingredient was labelled as "non-GM (0.1%)" and the tests confirmed that it contained no GM soya. The farmer had bought the feed from the company Grain Harvesters, though he said he had not requested non-GM feed and was unaware it was non-GM. Two samples were labelled as containing GM soya but our tests

did not identify any GM soya (both were pig feeds). One of these was a pure soya feed from Cargills and so can be classed as non-GM. The other was a compound feed from ABN and also labelled as containing "vegetable oil (produced from genetically modified soya)". As this may have contained undetectable GM soya, we have counted it as 'GM'. Apart from this, two other feeds had neither GM labelled ingredients nor were found to have GM soya after testing (both were pig feeds from BOCM Pauls). As they contained no soya or maize at all in their ingredients, we assume they did not contain any undetectable GM material and we therefore count these two as non-GM. (The feed with an illegible ingredients list contained no GM soya, but may have contained GM maize, so we could not classify it.)

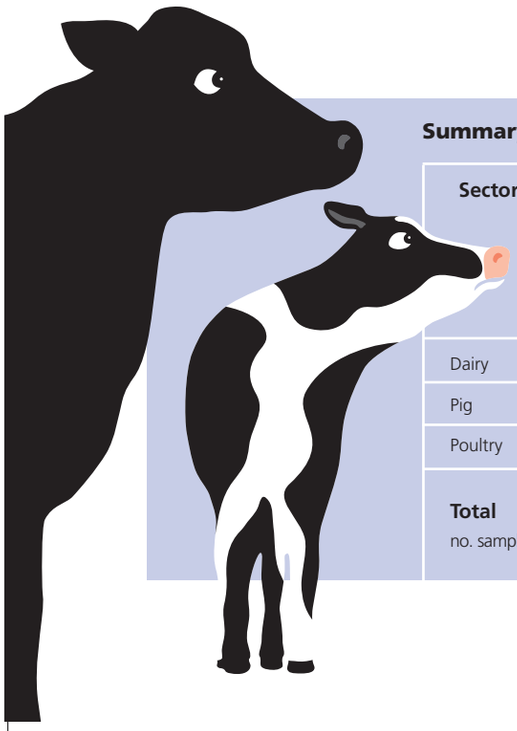
Soya is clearly the main identifiable GM ingredient. All three sectors widely used GM soya, with 31 samples containing soya in total and overall on average 35% of the soya in the feed being GM (calculated by averaging the GM soya percentage of the 31 samples which contained soya), which is a high level. The percentage that was GM out of the total soya was particularly high in the dairy cattle feeds at 51%. In the pig sector, on average 20% of the soya used was GM. The small number of poultry feeds that we tested had a surprisingly high level of GM soya, with 37% of the soya being GM. It was particularly worrying that of the four feed samples from egg producers, two contained GM soya and at high levels, at 32% and 70% GM (we afterwards ascertained that three of these were not 'free-range' egg producers; we could not ascertain the fourth). It was also concerning that the one broiler (chicken meat) feed that we tested and which was produced by one of the two largest poultry feed companies ABN, was 100% GM soya.

Strangely, the six feeds labelled as containing simply 'soya', rather than 'GM soya' or 'GM vegetable oil' (or 'non-GM soya/vegetable oil'), and which should all therefore have had soya that was less than 0.9% GM, all contained GM soya and overall contained particularly high levels. On average, 79% of the soya in these samples was GM. This was three times as much as the level of GM soya in the feeds that were actually labelled as containing 'GM soya' (of the 19 such feeds, 25% of the soya was GM). These six feeds included two pure soya feeds (as opposed to compound feeds) which were made of 100% GM soya, so these feeds were totally GM.

No GM maize was identified by our tests, but many of the dairy feeds were labelled as containing GM maize (nine of the 13 dairy feeds). In total, 13 of the 34 samples where we obtained the ingredients lists contained maize (38%, 11 dairy samples, one pig and one poultry sample). No GM oilseed rape was identified in our tests, although one pig feed was labelled as containing GM rapeseed. Consideration of the feed companies' sourcing policies (see later), indicates that much of this maize was GM – presumably around 50% on average– while the oilseed rape ingredients were almost totally non-GM.

Survey results – farmers' awareness of their use of GM feed

Our survey uncovered a worryingly low level of awareness among farmers about whether they are using GM feed or not. Since the introduction of compulsory European-wide GM labelling for animal feed in April 2004, all feed that contains or may contain GM ingredients has to be labelled. If the farmer wishes to check whether he is using GM feed, it is now very easy for the farmer to see if



Summary of the feed test results for soya

Sector	No. of samples (no. containing soya)	Average % of soya that was GM	Test results, number of samples, by category of % of soya that was GM (each figure shows the number of samples in each range)					
			No GM soya	0.1%–<0.9%	0.9%–<10%	10–<70%	70–<100%	100% GM
Dairy	13 (10)	51%	4	1	1	2	1	4
Pig	16 (13)	20%	5	2	5	2	1	1
Poultry	8 (8)	37%	1	1	1	2	2	1
Total no. samples	37 (31)	35%	10	4	7	6	4	6

any ingredients are labelled GM from the ingredients list, which usually accompanies the delivery note. As three-quarters of UK animal feed now contains GM labelled ingredients (according to our survey), we would have thought that most farmers would now be aware that most of their feed is GM (although we also found that an absence of a GM label does not mean the feed is definitely non-GM). However, of the 192 livestock farmers who responded to this question, 59% (114) said they did not know whether their feed was GM or not. Only 44 (23%) thought their feed was or maybe was GM, while 34 (18%) thought their feed was non-GM.

Interestingly, of the sub-group who provided samples, a similar percentage thought their feed was GM (seven of 29, 24%), but a much higher percentage admitted that they did not know (21, 72%) and only one said he thought he was using non-GM feed (3%). This may indicate that these farmers were giving a more honest assessment, knowing that their feed would be tested, than the 133 others who knew their feed was not being tested and who hoped or maybe wanted to suggest their feed was non-GM when really they were not sure. In other words, the level of unawareness among farmers might actually be nearer to 72% than 59%.

Our survey indicates that there is a low level of interest, at least, among farmers in using non-GM feed. Of the 29 farmers who provided samples, none were already intentionally using non-GM feed. However, one poultry farmer was in the process of moving to non-GM feed when we contacted him, and a dairy farmer decided to move to non-GM feed after we first contacted him. Furthermore, a beef farmer also decided to switch to non-GM feed after discussing the issue with us.

Survey results – breaches of the GM labelling law

Our survey found several breaches of the European GM labelling legislation. In total, seven of the 37 samples, 19% of the total, contained GM soya over the 0.9% labelling threshold but bore no GM soya or GM vegetable oil label. Our tests showed five of these contained soya that was over 80% GM, with the soya in the other two being 4% and 14% GM. Even considering the +/- 40% margin of error, it seems that these were all definite breaches. The breaches occurred in all three sectors and involved six companies.

These seven unlabelled GM soya samples were as follows. One sample, from Stephenson's Animal Feed, had been delivered to the farmer without an ingredients list and was found to contain soya that was 96% GM. Overall, seven samples had simply "soya" stated in the ingredients list or on the delivery note and no reference to the soya being GM or non-GM. Our testing found that all seven contained GM soya, with the soya in four being 80% or more GM. This included two pure soya samples made up of 100% GM soya, and two samples of BOCM Pauls turkey feed containing soya that was 14% and 81% GM. One, however, was a BOCM pig feed containing 1.2% GM soya labelled 'GM vegetable oil'; this could have contained soya oil which might have accounted for the presence of soya DNA. So, only of six of these can be considered breaches, making seven cases of mislabelling in total.

Of the 19 feeds that were labelled as containing GM soya, the tests confirmed that 17 contained GM soya and the soya was on average 25% GM.

Reassuringly, our tests did not identify any GM soya in the only sample that was guaranteed non-GM (the soya was labelled as "non-GM (0.1%)"). Confusingly, another sample had a soya ingredient labelled as guaranteed non-GM soya (with a mention of IP) but this feed had two other soya ingredients (soya oil and full-fat soya) that were not labelled as guaranteed non-GM; the sample contained a low level of GM soya.

3.2 Survey of the feed company policies on GMOs

In 2006, we wrote to most of the large UK feed compounding companies, and a few smaller companies, to ask about their use of GM animal feed. We received replies from 10 companies: BOCM Pauls, ABNA, Carrs Billington, NWF, Mole Valley Farmers, Massey Bros (Feeds) Ltd, Stobart & Sons, Farmway, Grain Harvesters and Hi Peak Feeds. We are grateful to the companies that replied. Five companies did not reply to our letter: Heygates & Sons, Davidson Brothers, Scotts of Omagh, Stephenson's Animal Feeds and Ballinaskeagh Grains. Although these were mostly smaller companies, it was disappointing that they did not feel it important to be transparent about their policies, considering their role in food production. The replies are summarised in the table on page 20. We also corresponded with some of the poultry integrators:

Grampian, Deans Foods and Lloyd Maunder – see sections 3.4 and 3.5 on poultry sectors.

All of the feed companies who replied stated that they use GMOs, except for Hi Peak Feeds which was providing entirely certified non-GM feeds.

The reply from ABNA was very interesting, explaining how they have responded to the challenge of GM feed on behalf of the whole industry. They explained that, with AIC, the feed trade association, they were instrumental in devising the non-GM module of FEMAS (Feed Material Assurance Scheme). This certifies as non-GM certain sources or suppliers of feed materials coming from countries where there are GM varieties of feed materials available alongside non-GM, and so where specific measures (segregation, testing etc.) are essential along the whole supply chain from sowing to delivery in the UK. This is clearly a very good and responsible initiative that provides a base for all other feed companies operating to the FEMAS standards to use, to provide certified non-GM feeds feed to their customers.

However, it was disappointing that, apart from ABNA and Hi Peak Feeds, none of the other feed compounding companies mentioned any significant steps they had taken to avoid non-GM feed beyond the requirements of the supermarkets, although one smaller company, Grain Harvesters, said it had previously had a non-GM ingredients policy.

Three companies said that they 'preferred' to source non-GM (Carrs Billington, Mole Valley Farmers and Grain Harvesters). But Carrs Billington and Mole Valley Farmers said that they cannot provide non-GM for 'some ingredients' (presumably soya and maize), and that they use commodity markets or shippers for sourcing these ingredients (which we assume means the normal markets providing unsegregated supplies). They did not mention any measures they had taken for avoiding GM soya or maize. Therefore, in practice these companies are likely to be routinely using GM soya and maize. The response of Grain Harvesters, a small company, was similar, but it said that until 18 months ago it had a non-GM policy but were obliged to drop this due to the growing price difference between GM and non-GM soya. They now offer a choice of GM and more expensive non-GM feed, and estimate that about 60% of their feed contains some GM soya or GM soya oil.

Five companies said their use of non-GM feed is 'customer-led'. This would mean that they only provide non-GM feed if requested by the farmer or processor that they supply. With the exception of the feed used by the poultry integrators, which we could not test adequately, our survey has indicated that most feed contains GM ingredients and few farmers are requesting non-GM feed. Therefore, most feed companies with such policies are almost certainly using substantial amounts of GM feed in practice, unless they are mainly supplying poultry producers. (The significant level of non-GM feed supplied by Grain Harvesters, at an estimated 40%, may be partially because they were previously committed to non-GM and so would have attracted clients who had this preference).

The specific sourcing information we gathered made it clear that much, and probably most, of the soya and maize used in the UK is from GM sources, except for poultry feed. Where the country of origin was specified by any of the nine companies who were not using only non-GM feed, soya is being bought from US, Argentina and Brazil, and maize gluten mainly from the US. For companies which said they are buying soya and maize from 'importers' or 'shippers', their supplies are likely mainly to originate from the same countries, and anyway not usually from non-GM countries. This confirms the results of our testing programme as regards soya – that, apart from the poultry sector, most soya used in feed contains a large proportion of GM soya.

As three of the companies say they buy their maize from the US, this indicates that most of the maize used by the UK feed industry must contain a very significant amount of GM maize.

On the other hand, we were pleased to find that all or nearly all oilseed rape is bought from non-GM sources (UK or Europe), going by the replies of the five companies which gave their rape source and our information that Europe is nearly self-sufficient in oilseed rape. We conclude that the reason why our tests did not find any GM oilseed rape was because, as well as often being refined, it was also nearly all non-GM.

The companies were asked if they supply any guaranteed non-GM feeds to their customers for feeds containing materials that could be GM, namely feeds containing soya, maize or oilseed rape. Two did not answer this question (Massey Bros and Stobart & Sons). Six companies answered yes. There were a range of answers and it is clear that the companies are providing non-GM feeds in two main ways. Only for five companies was it clear that they are really providing non-GM feeds containing soya, maize or oilseed rape, and four of these said they were using certified non-GM sources: ABNA, BOCM Pauls, Grain Harvesters and Hi Peak Feeds. ABNA and BOCM Pauls said they use certified Identity Preserved (IP) sources through the FEMAS or other schemes, for their non-GM feeds. ABNA also said they use

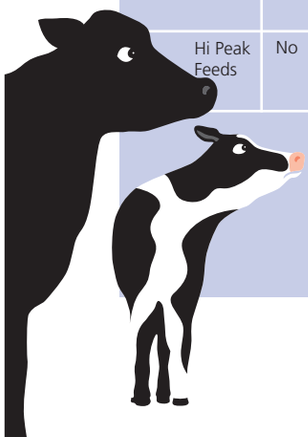
contracts for all their supplies, which would give them some control over their sources. Grain Harvesters said they only use certified sources for their non-GM feed. However, while they believe their management practices significantly reduce any risks of contamination, Grain Harvesters do not actually guarantee that any of these feeds are totally non-GM because of the risks of cross-contamination. (Nevertheless, one of our feed samples was from them and was labelled "non-GM (0.1%)" which certainly implied that it was guaranteed to that level.)

Other companies are not using certified non-GM sources and are providing guaranteed non-GM feed only by excluding those raw materials which could be GM, such as Mole Valley Farmers. NWF said they do a range of feeds for different markets, including non-GM feeds of different formulations. They do not use any certified feeds and said they do not actually guarantee that their non-GM feeds are free of GM material, except for feeds where they have not used any raw material types that could be GM, such as by using wheat and sunflower, instead of soya and maize. However, they do provide some other non-GM feeds that contain uncertified raw materials of the crops that could be GM but where, in the case of their sources, are not GM at the farm origin, such as feed containing maize by-products from France. The company was keen to point out they use little maize and mainly use home-grown cereals, such as wheat and barley. This was positive as in

Feed companies' policies on GM ingredients

	Does the company **use any GM ingredients?**	Do you have a **company policy** or aims on the use of GMOs?	**Where do you source** your ingredients?	Do you supply **guaranteed non-GM feeds?**	How much more expensive is your non-GM feed than GM feed %?
BOCM Pauls	Yes	Customer-led	Soya: US, Argentina & Brazil; maize gluten: US; oilseed rape: EU	Yes, if required; they use IP sources (FEMAS or SGS)	Ingredients: soya 7% more, maize 9%. Feeds: depends on inclusion rate
ABNA	Yes	Customer-led	All on contract: soya: Brazil, N America & UK; maize gluten: N America; maize grain: mainly France; oilseed rape: mostly UK	Yes, their non-GM feed has to be from certified IP sources (FEMAS or other)	Soya meal premium is up to £14/t; non-GM oils particularly costly
Carrs Billington	Yes	Prefer non-GM, for some ingredients impossible	Soya & maize from shippers; oilseed rape: UK	Yes, by excluding raw materials that may be GM	For cattle feeds, £1–5/t more
NWF	Yes	No	Soya: imported commodity markets; maize gluten & by-products: commodity markets & France/ EU; other cereals: UK	Yes, only by excluding raw materials which could be GM (eg. no soya; instead use wheat, sunflower etc)	Different formulations, variable
Mole Valley Farmers	Yes	Prefer non-GM	Generally, shippers or importers	No guaranteed GM-free feeds if ingredients might be GM	No answer
Massey Bros	Yes	No	Soya: N & S America; maize: US; oilseed rape: Europe	No answer	Up to £25/t more
Farmway	Yes	No, some customers require non-GM	Soya & maize: US; oilseed rape: EU	Yes, on request	If high soya content £3–5/t more, if no soya just a few pence
Stobart & Sons	Yes	No	Normal merchants	No answer	Approx. £6/tonne more
Grain Harvesters	Yes, estimate c.60%	Prefer non-GM but now only customer-led, no non-GM policy	Shippers & processors. No use of maize gluten or straight maize	For non-GM feed, use certified non-GM soya; believe they minimise contamination risk in mill	Varies from £1–12/t, averages at £5–6/t for customers buying on contract
Hi Peak Feeds	No	Only use non-GM	Certified Brazilian non-GM soyameal; maize gluten: France	Yes, all feed is certified non-GM	Not applicable

Source: Soil Association survey, 2006; additional correspondence with ABNA, BOCM Pauls, Grain Harvesters and NWF in 2007.



the long-term the use of home-grown feeds must be a preferable way of reducing the use of imported GM feeds and the risk of GM contamination.

A range of prices was quoted for how much more non-GM feed would cost. This is because the price differential largely depends on how much soya is in the feed, which can vary between 0% to 25% of the total for compound feeds. BOCM Pauls said non-GM soya costs about 7% more than GM soya (£148/tonne vs £138) and non-GM maize gluten costs about 9% more (£93/t vs £85). Depending on the amount of soya and maize used, the cost of non-GM compound feeds ranges from a few pence to £6/t more. Grain Harvesters said that many clients buy on the contract and their non-GM premium averages around £5–6/t. We cannot explain the very large price difference given by Massey Bros (£25/t more); they were perhaps referring to the pure soya ingredient, rather than the mixed feed, but it is very high compared to the BOCM and other market information. Both ABNA and Grain Harvesters said the price premium of non-GM materials has been increasing. ABNA said that the premium for certified non-GM vegetable oils is particularly costly because of the lack of segregation in the supply chain.

It should be noted that the companies selling IP non-GM soya say that some of the feed companies exaggerate the costs of non-GM soya. Understandably, many of the feed companies do not welcome the work of sourcing and guaranteeing non-GM feed supplies unless they really have to and are sure they can do so reliably, and they are concerned about the extra costs and whether they can remain competitive with other companies and imported products. In our view, they are almost certainly being heavily influenced by the soya industry which appears to be exaggerating the cost and difficulty of supplying non-GM soya. As explained by the UK's National Farmers' Union, Cargill and ADM, who together control over half the world soya feed market, have commercial links with Monsanto (for Cargill) and Novartis/Astra-Zeneca and Dupont/Pioneer (for ADM).[3] This means that the main players in the global soya industry are not independent but are involved in the promotion of GM soya and so supplying non-GM soya has not generally been in the industry's interests.

3.3 Supermarket policies on GM feed

Compared to their excellent performance in ensuring the public are eating food with non-GM ingredients when they buy their own brand products, the supermarkets have a poor record when it comes to the use of GM feed. Apart from Marks & Spencer which deserves recognition for its leading action and the important exception of the poultry sector, the supermarkets have taken almost no steps to use non-GM feed. We know, from meetings and correspondence with the supermarkets, that many have considered the issue and we greatly welcome the efforts they have made to use non-GM feed for poultry. However, apart from Marks & Spencer and poultry, they are widely accepting the use of GM feed and have not been at all open about this to the public.

The supermarkets are not labelling which of their meat or dairy foods are produced with GM feed and they have been reluctant to even admit they are using GM feed. They are, in our view, generally hiding their lack of action on this issue behind their non-GM food policies and taking advantage of the fact that there is no legal requirement for meat and dairy foods produced from GM-fed animals to be labelled. What is worse, is that they have not even clearly been informing members of the public when they have specifically asked about GM feed. Over 800 of our supporters wrote to the supermarkets asking about their use of GM feed. The responses were extremely disappointing, typically inconsistent, obtuse and often actually misleading. Only Marks & Spencer, the Co-op and Booths were consistently explicitly stating whether their food is from GM-fed animals. Many retailers were conflating the issue of GM feed with GM food ingredients and the availability of organic products. Many deferred responsibility for sourcing non-GM feed to the farming industry or blamed 'lack of availability'. As this subject concerns the production of the food people are eating and is something people feel strongly about, we consider this treatment of the public to be unacceptable.

In August 2006, Friends of the Earth (FoE) carried out a survey of the supermarkets' policies on GM feed.[4] This only covered their own-brand fresh produce, not other brands or frozen and processed products. Friends of the Earth did not receive replies from Sainsbury's and Morrisons, so information about these two was obtained by Friends of the

Earth from customer service enquiries and correspondence with other organisations. We sent this information back to the supermarkets in June 2007, asking to be informed of any changes in their policies since the survey. Only Marks & Spencer, Waitrose, Co-op, Somerfield, Morrisons and Budgens took the trouble to reply, although Budgens did not tell us about their poultrymeat or pork. For Sainsbury's, we referred to a recent response to one of our supporters on their feed policy. Through additional specific requests, we also managed to obtain information from Iceland on their feed policy, and from Sainsbury's on their GM-free milk option and their policy for their eggs. Where we had no information from the supermarkets, we have used the poultry industry's information and otherwise assumed that Friends of the Earth's findings for 2006 still apply (except for Budgens' pork where we did not feel confident about the 2006 information). See table below for our findings.

Positively, all of the supermarkets said their own-label fresh chicken, turkey and eggs are being produced from non-GM feed, apart from Iceland, and this was confirmed by the feed company and poultry industry information. Farmed fish are also being produced from non-GM feed.

On the other hand, the survey shows that nearly all of the supermarkets' own-brand, non-organic milk, dairy products, pork, beef and lamb are generally from GM-fed animals. The responses for milk, dairy products and pork are supported by our test results, which found wide use of GMOs. We did not test feed specifically intended for beef cattle and sheep. However, beef cattle and sheep are often fattened on concentrate feed (including compound feed). As our research showed that the feed companies do not generally provide non-GM feed unless the farmer specifically requests it, and most farmers are currently not considering this issue, it can be assumed that beef cattle and sheep may well be commonly given GM feed, unless they are only grass-fed.

The survey confirmed that Marks & Spencer is the only supermarket to have adopted a general non-GM feed policy for all of its fresh milk, meat and eggs. They have had this policy since 2002. As well as the products listed in the table, their non-GM feed policy also applies to their fresh duck, goose, veal, venison and prawns.

Supermarket policies on the use of GM animal feed in own-brand fresh products

	Milk	Other dairy	Pork	Beef	Lamb	Eggs	Chicken	Turkey	Farmed fish
Marks & Spencers	✓	☹	✓	✓	✓	✓	✓	✓	✓
Co-op	☹	☹	✓	Aberdeen Angus, Scotch	New Zealand	✓	✓	✓	✓
Sainsbury's	GM-free option in some stores	☹	Taste the Difference, outdoor-reared pork and bacon	Taste the Difference, Traditional	☹	✓	✓	✓	✓
Waitrose	Goats' milk	☹	☹	☹	Dorset, New Zealand	✓	✓	✓	✓
Tesco	☹	☹	☹	☹	☹	✓	✓	✓	✓
Asda	☹	☹	☹	☹	☹	✓	✓	✓	✓
Morrisons	☹	☹	☹	☹	New Zealand	✓	✓	✓	✓
Somerfield	☹	☹	☹	☹	☹	✓	✓	✓	✓
Budgens	☹	☹	?	☹	☹	✓	✓	Fresh pieces	Salmon
Iceland	☹	☹	☹	☹	☹	☹	☹	☹	☹

Key

✓ = supermarket requires (or has confirmed) use of non-GM animal feed

☹ = use of GM animal feed is allowed (otherwise, use of non-GM feed is limited to products stated).

Pork does not include cured products such as bacon, unless stated otherwise. Farmed fish refers to trout and salmon.

Source: Friends of the Earth: August 2006, updated by the Soil Association for August 2007

And, as they only sell their own-brand products, this applies to all the fresh foods they sell. We also understand that they also use only non-GM fed 'free-range' eggs in their processed products. However, we must stress that we believe their non-GM feed policy does not cover their frozen and processed meat and dairy foods, so even Marks & Spencer may be selling products from GM-fed animals.

As well as its fresh own-label chicken, turkey, eggs and farmed fish, Sainsbury's offers several other non-GM feed options under its quality non-organic lines, such as the beef and pork products in its Taste the Difference range. Its GM-free milk option was introduced in 2004 as a pilot scheme. It was rolled out to all its large stores in 2005, and is now called Sainsbury's 'Farm Promise' milk. However, it is only available in 2 litre bottles of semi-skimmed milk, which offers little choice. Sainsbury's does not require the use of non-GM feed for its battery eggs, although it said that its suppliers are all committed to using non-GM feed.

The Co-op and Waitrose also offer a few non-organic meat and/or dairy items produced from non-GM feed, besides their fresh chicken, turkey, eggs and farmed fish. Waitrose helpfully gave us other details on their position. They said, "It is the Waitrose objective to use non-genetically modified crops in animal feedstuffs, where it is commercially viable to do so, from sustainable sources." They said they have a GM avoidance policy in place with their beef supplier, but due to "the limited vertical integration" in the sector, it is hard for them to demonstrate compliance. Despite this limitation, this is good to know and a positive move towards eliminating the use of GM feed. Waitrose also said that they do not know if the oils in the feed are GM or non-GM as they are from commodity markets. This is disappointing: soya oil will be mostly GM but there are non-GM sources available; other oils, like sunflower oil, are non-GM.

Supermarkets which are offering few non-organic meat and dairy products from non-GM fed animals, besides their fresh own-label eggs, chicken, turkey and farmed fish, are: Tesco, Asda, Morrisons, Somerfield, and Budgens. Morrisons said it is their "preference" to use products from animals reared on non-GM feed and are keeping "this matter under regular review". Budgens' information for eggs was inconsistent with FoE's findings in 2006, when Budgens had apparently said they allow GM feed; this may be because they are relying on their suppliers for the use of non-GM feed, rather than having their own non-GM feed specification.

Iceland is the only supermarket that said it is not requiring non-GM feed for the production of any of its livestock products. The fact that Iceland is the only major supermarket in this position comes as a surprise and is very disappointing as it was the first supermarket to adopt a non-GM policy for its food ingredients. This is particularly regrettable for its poultrymeat and eggs, where products from non-GM feed sources are widely available within the UK. However, although it does sell some fresh meat, it mainly sells frozen foods, so it is not in a comparable position to the other supermarkets. Presumably, as a specialist in frozen foods, it is relying much more on imported sources, where non-GM products are probably not widely available. Nevertheless, we urge it to review its policies and use UK sources that use non-GM feed, initially at least for its poultrymeat and eggs.

It is important to stress that this survey provides only a partial picture of GM feed in our food supply, for four reasons. Firstly, the major categories of frozen and processed products are not covered by this survey. For example, our survey shows that the Marks & Spencer non-GM feed policy does not apply to processed dairy products, and our supporters' correspondence with Marks & Spencer also revealed that their non-GM feed policy specifically applies to their fresh meat, so their frozen meat is also not covered. We also know that Iceland does not require the use of non-GM feed in the production of any of its frozen meat and dairy products. In common with all other supermarkets, these exclusions are very significant – see later section on imports. Sainsbury's, however, informed us that all their own-label frozen chicken is produced with non-GM feed. Morrisons also said that their fresh and frozen chicken and turkey is British and thus produced with non-GM feed, which is excellent.

Secondly, this survey is limited because these supermarket policies only apply to own-brand products; the supermarkets have made no attempt to eliminate the use of GM feed from the other products they sell (this shortcoming does not apply to Marks & Spencer who only sell their own-brand products). Thirdly, our survey did not cover the smaller low-cost supermarkets, such as Aldi and Lidl, small regional chains like Booths, or numerous independent retailers. Fourthly, our survey did not cover the substantial amount of food used in the restaurants, take-away and hospitality sectors.

3.4 The supermarkets' non-GM feed policies for poultrymeat

Most of the fresh chicken and turkey in the supermarkets is supplied by British poultry producers and this sector stands out for having generally eliminated the use of GM feed throughout the industry. This is excellent. However, ascertaining this situation was not straightforward. Our ability to directly test feed samples was very restricted. It was unclear at the outset which parts of the industry were determining the use of non-GM feed – whether the feed industry, farmers, industry-wide standards or supermarkets' specifications. Accessing the information from the industry was not easy and the information from the different sources was not always consistent.

On the one hand, these supermarket statements, the information provided to us by Grampian – the main supermarket poultrymeat supplier – and Lloyd Maunder, and past statements by the poultrymeat industry, all confirmed the non-use of GM feed. Grampian is the main UK poultrymeat producer and supplier of most of the supermarkets. It said the majority of their feed is non-GM and in fact GMOs account for a "small minority" of their output. They also said they use contracts, which would give them much more control over their supplies, and they do their own testing. Interestingly, Lloyd Maunder, another poultrymeat producer told us that they do not use any GM feed, although our exchange with them came too late to request a sample for testing from them.

Other information, however, did not actively support the conclusion that the UK poultrymeat sector is mostly non-GM. The members of the British Poultry Council, which represents poultrymeat producers, adhere to the Assured Poultry standards. These are identified by the Little Red Tractor logo on products. But there is no requirement to avoid GM feed within those standards, which we had expected to find if there was an industry-wide policy on non-GM feed. In addition, despite their earlier public claims that they were removing GM feed, we could find no mention of non-GM feed on the websites of either Grampian or Bernard Matthews, nor any mention on the British Poultry Council's site. It was also concerning that the single broiler feed sample that we managed to test contained 100% GM soya, while two of the three turkey feed samples contained high levels of GMOs.

Then, in a letter in April 2007 to the *Guardian*'s *Weekend* magazine, the British Poultry Council, which represents poultrymeat producers, said "both [organic flocks and birds reared indoors] use non-GM feed ingredients, in the UK at least".[5] When we contacted the British Poultry Council in May 2007, we were told by Jeremy Blackburn, the executive officer, that the supermarkets all insist on the use of non-GM feed for their poultrymeat, although it is not a requirement of the Assured Poultry Standards. All the major poultrymeat operators supplying the supermarkets, directly or indirectly, are required by the supermarkets to use non-GM feed and they have to obtain non-GM certificates for each shipment of feed. The vast majority of the poultrymeat sector's feed therefore comes from Brazil, rather than the US, with a smaller amount coming from Eastern Europe. He confirmed that the poultrymeat sector was unusual in using non-GM feed.[6]

This was reassuring. However, the general lack of transparency in the poultrymeat sector is unsatisfactory. There is a need for independent verification of the poultrymeat sector's non-GM claims, particularly given the poor situation in the dairy and pig sectors, the confusing inconsistencies between the different sources, and the results of our few tests. It is therefore regrettable that Grampian refused to let us test their feed.

Although the lack of transparency is a concern, we accept the supermarkets' and poultry industry's statements and conclude that supermarket own-label fresh poultrymeat, and Lloyd Maunder poultrymeat, are indeed from non-GM fed bird. As the supermarkets account for the vast majority of UK chicken production – 85% of chickens reared for meat go to processors for the supermarkets, 15% go to processors for the wholesale and catering markets[7] – this means the vast majority of UK chickens are therefore covered by this non-GM feed policy.

Nevertheless, this does not mean that the vast majority of all chicken consumed in the country is produced with non-GM feed as there is a large use of poultrymeat outside the supermarkets' fresh poultrymeat sales which is supplied by importers, such as imported frozen chicken supplies which are commonly used in processing and catering (see 3.6).

3.5 The supermarkets' non-GM feed policies for eggs

Our research suggests that around two-thirds of all eggs produced in the UK are being produced with non-GM feed, including nearly all of the supermarkets' own-label eggs, nearly all 'free-range' and 'barn' eggs sold nationally, and all organic eggs. Among the major supermarkets, only Iceland is allowing GM feed for the production of all of its eggs. The brands 'Woodland free range', 'Corn Gold free range', 'Columbus omega-3 rich' and 'Church and Manor' duck eggs are also produced with non-GM feed. However, around half of all caged (battery) eggs in the country are being produced with GM feed, including some 'Big and Fresh' caged eggs and perhaps other brands being sold in the supermarkets, perhaps most of the caged eggs being sold by independent retailers, and probably most of the caged eggs used in processing and catering. We are also concerned that some 'free-range' eggs being sold locally and by independent retailers may be being produced with GM feed.

It was very difficult to ascertain this situation. This was for the same reasons as in the poultrymeat sector but with the additional complication that the use of GM feed was different for eggs from caged and non-caged birds and also because the supermarkets sell various egg brands, not just their own-label eggs.

The Friends of Earth survey in August 2006 had indicated that all of the supermarkets' own-label eggs were from non-GM fed chickens, with the exceptions of Sainsbury's – where only their 'free-range' eggs were from non-GM fed chickens – and Budgens. We re-checked the situation with the supermarkets and, to verify their claims and to identify the general situation for other egg brands and other retail outlets, we tested feed samples from four farms and contacted the two main UK egg supplying companies, Deans Foods and Stonegate, and another major UK egg producer, John Bowler. We also contacted the British Egg Industry Council about the standards for 'Lion Quality Eggs', to which 85% of the UK egg industry adheres, and we corresponded with the British Free Range Egg Producers Association (BFREPA).

We were pleased to find out, from the supermarkets that provided information, that all but one of the supermarkets surveyed require non-GM feed for their own-label eggs (or confirmed non-GM feed is being used, in the case of Sainsbury's caged eggs). Tesco and Asda did not reply but Deans Foods informed us that they also require non-GM feed for all their eggs. Only Iceland does not require the use of non-GM feeds or use suppliers known to be using non-GM feeds.

Sainsbury's currently only requires non-GM feed for the production of its 'free-range' and 'barn' eggs and is not requiring non-GM feed for its caged eggs. However, Sainsbury's has committed to phasing out caged eggs before 2012,[8] and they said that all of their caged eggs are anyway from companies that are committed to using non-GM feed. (This is at odds with statements from Deans Foods and Stonegate, the two main supermarket egg suppliers, that they do not have non-GM feed policies for their caged egg production, and that the use of non-GM feed for caged eggs depends on the requirements of the customer. We assume that Sainsbury's use a different caged egg supplier.) Budgens, who had told FoE in 2006 that they allowed the use of GM feed for their eggs, told us that all of their own-label eggs are produced with non-GM feed and none are from caged hens. Nevertheless, they sell caged eggs from another brand ('Oasters'), in one store at least, and we could see no label to indicate that non-GM feed is used for these. So, people who shop in Budgens and buy caged eggs will be getting eggs that may be produced with GM feed. Marks & Spencer and Waitrose do not sell caged eggs.

The information we obtained from the egg industry supported these positive conclusions about the supermarkets' non-GM feed policies for eggs. However, this also revealed that the situation for eggs sold outside the supermarkets, and perhaps for some other egg brands sold in the supermarkets, is not so good, with a major difference in the use of GM feed between 'free-range' and 'barn' eggs, and caged eggs.

Noble Foods, the new company from the merger of Deans Foods and Stonegate, is the largest UK egg producer. Deans and Stonegate are the biggest suppliers of fresh shell eggs, including 'free-range' eggs (Deans have 4.5 million 'free-range' laying birds and Stonegate have 2 million 'free-range' laying birds[9]), and together they supply three-quarters of the retail egg market. They are also the largest suppliers of processed eggs.[10] They merged in late 2006 but, in April 2007, the Competition Commission said the new company, Noble Foods, must sell Clifford Kent Holdings, the parent company of Stonegate.[10]

According to its website, "Deans is the

leading supplier of fresh eggs to all the major retailers". The company has several brands found widely in the supermarkets: 'Columbus omega-3 rich' eggs, 'Woodland free range' eggs, 'Corn Gold free range' maize-fed eggs, 'Big and Fresh' eggs, and 'Church and Manor' duck eggs. The website also says, "Deans have been instrumental in developing GM and colourant free hen diets, a move which has been followed by the majority of the UK egg industry." On another webpage, Deans say, "GM soya is used by some producers but as a matter of policy has been excluded from all Deans feeds."[11] These statements were there during 2006 and at least until April 2007.

In August 2007, Deans Foods told us that only three-quarters of their eggs are produced with non-GM feed, including all of their eggs from non-caged birds ('free-range' and 'barn' eggs), which account for half of their eggs. They explained that their use of non-GM feed is now determined solely by the supermarkets' requirements, and they do not have their own policy. Of Deans' own brands, they said all of their non-caged eggs are produced with non-GM feed, as well as the caged version of 'Columbus' and their 'Church and Manor' duck eggs (their 'Woodland' and 'Corn Gold' eggs are all non-caged, but their 'Columbus' and 'Big and Fresh' eggs have caged and non-caged versions). Of these five brands, only some of the caged version of their 'Big and Fresh' brand is produced with GM feed.[1]

Importantly, according to Deans, the retail, processing and catering markets are not separate and most 'free-range' and 'barn' egg producers are on contract to one of the larger egg packers. This means that the supermarket policies for non-caged eggs affect the whole industry. Deans therefore estimate that at least 95% of the 'free-range' and 'barn' eggs produced in the country are from non-GM fed chickens.[1]

Deans explained that they implement their non-GM requirements in all their non-caged feed by requiring all their non-caged producers to complete an annual declaration that their feed is non-GM and from an IP source. They accept the schemes approved under FEMAS, such as Cert ID, FEMAS non-GM standards or SGS. Additionally they regularly test the non-GM feed in their feedmills, which supplies the feed for around 50% of their eggs.

In contrast, however, Deans said that only about half of the caged eggs they supply are produced with non-GM feed. Although most of the supermarkets require that their own-label caged eggs are produced with non-GM feed, only some processors do. Deans said that until spring this year they had required that the producers of all of their caged eggs used non-GM feed, even though not all of their caged egg customers were requiring it. Now, however, they are only requiring non-GM feed if their caged egg customers are requesting this, which accounts for about half their caged eggs sales. They think this proportion of non-GM feed used for caged eggs may be similar across the industry.[1]

The information from Deans was supported by statements from Stonegate. Stonegate are both egg producers and packers; they own some farms and have 250 producers that supply eggs. They supply the supermarkets Sainsbury's, Asda, Waitrose, the Co-op, Iceland, Somerfield, Morrisons, and Aldi, and the large food companies Northern Foods, Allied Bakeries, Greggs Bakeries, Geest, 3663 (the large food service catering company), and Costco (food wholesaler).[12] They told us that they use non-GM feed when required by their customers, and that their two main customers who require non-GM feed are Waitrose and the Co-op.[13] They said their use of non-GM is mainly for their 'free-range' birds, while they use 'any origin soya' for their caged egg production.

The John Bowler Group supplies 'free-range', 'barn' and organic eggs (no caged eggs) exclusively to Stonegate (except for a small amount sold as farmgate sales). It operates a franchise-based system with 95 farms that together have 1.2 million laying birds. John Bowler supplies its franchisees with feed bought from Lloyd's Animal Feeds and BOCM, and a small amount from Deans Feed.[9] Unfortunately, when we contacted John Bowler, we were told that, "John Bowler (Agriculture) Ltd has a policy of not releasing the content of its feed diets."[14] It was disappointing and concerning to find that any food company should have a policy of secrecy over its inputs.

The finding that the use of non-GM feed is being determined by the supermarkets and food processors, rather than the poultry industry or feed companies, was confirmed by the egg industry body representatives. We were told by the British Egg Industry Council that the 'Lion Quality Egg' Standards do not require the use of non-GM feed.[15] The British Free Range Egg Producers Association also told us that the standards for 'free-range' egg production do not require the use of non-GM feed.[16] Checking the standards for Freedom Foods, again we found no reference to non-GM feed.[17] This was surprising given the statement by BFREPA in 2001 that all 'free-range' eggs produced to Lion and Freedom Foods standards would be produced using non-GM feed.

As there are no industry-wide standards for non-GM feed use, apart from for organic eggs, this means that there is a concern over other egg brands in the supermarkets and

eggs being sold locally or by independent retailers. According to Deans, most 'free-range' and 'barn' egg producers would be supplying packers who are supplying the supermarkets and so would be producing to the supermarkets' non-GM feed requirements. However, this would not apply to any 'free-range' and 'barn' egg producers who are only selling locally or to independent outlets, though this must be a small proportion of the total (less than 5% of the total 'free-range' and 'barn' eggs suggest Deans and BFREPA). The situation is far worse for caged eggs, though. According to Deans, the supermarkets' non-GM feed policies for caged eggs account for over half the whole retail market for caged eggs. As the producers of caged eggs now use GM feed except where their customers specify otherwise, and around half of caged eggs are being produced with GM feed (based on Deans' sales), this seems to imply that a majority of caged eggs sold under other brands including those sold locally or through independent retailers are being produced with GM feed.

Evidence of the use of GM feed by smaller egg producers emerged from our own feed testing of four egg-producing farms, none of whom were from the major egg-producing companies. The feed from all four contained some GM soya, with two having high levels (32% and 70% of the soya being GM). Three of the farmers did not know whether their feed was GM, though all four feeds were labelled as containing GM soya. Three of the four farmers were not 'free-range' egg producers (we did not manage to find out the fourth). This, albeit small amount of, testing suggests that avoiding GM feed is not a common concern among smaller egg producers (at least among non-'free range' egg producers) and confirms that the feed companies are supplying GM feed to egg producers unless the farmer requests non-GM feed.

This difference between supermarket own-label eggs and eggs sold through other outlets seems important as there is often a perception among the public that locally produced foods or foods sold by small independent retailers may be less industrially produced than foods in the supermarkets. However, in this aspect, the opposite appears to be true. We would therefore recommend that the public assume any non-organic eggs sold outside the major supermarkets, and other brands sold by the supermarkets, may be produced with GM feed unless labelled otherwise.

The wide use of GM feed for caged egg production is a major concern, especially as this is a recent development. For animal welfare reasons, we would anyway strongly advise food companies and the public to avoid eggs from caged birds, but this now provides an additional reason. A big concern is the caged eggs used for processing and catering. An increasing number of food companies are using 'free-range' eggs, which is excellent as these should be nearly all non-GM. However, many companies are still using 'caged' eggs, so egg-based foods from most of these will often now be produced using GM feed, unless they have non-GM feed policies. We have not investigated the processing and catering sectors and so cannot provide any details on this. Nevertheless, now that GM feed is being used in UK caged egg production, we urge all food companies to review their egg supplies and adopt non-GM feed policies.

The information from Deans has enabled us to roughly estimate the level of use of GM feed in the egg sector nationally. 63% of eggs are now from caged systems, 27% from 'free-range' systems, 5% from 'barn' systems and 5% from organic farms.[18] Applying Deans' percentages for non-GM feed use to the whole industry, and the fact that all organic farms use non-GM feed, suggests that around 67% of eggs produced in the country are being produced with non-GM feed, two-thirds of the total ($0.5 \times 0.63 + 0.95 \times (0.27 + 0.05) + 1 \times 0.05 = 0.67$). If, however, the level of use of GM feed is higher for other egg packers (such as could be the case for caged eggs if other packers are supplying a higher percentage of other brands, processors and caterers than Deans) then this figure for non-GM feed use will be an over-estimate. On the other hand, the level of 'free-range' and organic egg sales are increasing each year and will push the figure up.

In summary, based on our research, we believe that reliable sources of eggs from non-GM fed chickens for the public are as follows:

- all organic eggs
- all own-label eggs in the major supermarkets, except Iceland
- brands 'Woodland', 'Corngold', 'Columbus' and 'Church and Manor' duck eggs
- any other eggs labelled as produced with non-GM feed.

Places selling eggs which may have been produced with GM feed, unless labelled otherwise, are:

- Iceland
- 'Big and Fresh' and other caged egg brands in the supermarkets
- all non-organic eggs sold locally or by independent retailers
- eggs, except 'free-range' eggs, used by restaurants, hotels, processed food manufacturers and the rest of the hospitality sector

In the absence of obligatory GM labelling for meat and dairy products produced with GM feed, the lack of any industry-wide non-GM feed standard in the egg industry, outside the organic sector, is unsatisfactory. This makes it almost impossible for consumers to select between the eggs produced with GM and non-GM feed unless they have been able to inform themselves by reading a review of the situation, such as in this report. This lack of transparency not only denies consumer choice but means the public cannot support the significant effort that the supermarkets and egg industry have put into ensuring a high level of use of non-GM feed all these years, which is a great pity.

In particular, the lack of a standard requiring non-GM feed for 'free range' means that 'free-range' birds may be GM fed. This is both surprising and unsatisfactory, especially given the commitment of BFREPA in 2001. A high proportion of consumers pay more for 'free-range' eggs to ensure that the birds have led more natural lives. We believe the public would not expect any 'free-range' birds to be routinely fed GMOs, or even for this to be allowed in principle. People are also being encouraged to buy food more locally and consumers who make this decision often have an interest in buying less industrially produced foods, such as 'free-range' eggs. In our view they would probably feel particularly let down to know that local eggs are actually less reliable in this aspect than eggs in the supermarkets. We therefore believe strongly that 'non-GM feed use' should be an automatic requirement of the 'free-range' standards and urge BFREPA and Defra to address this issue.

We have a similar concern about the 'Freedom Foods' label. Set up by the RSPCA, a widely trusted and respected animal welfare organisation, this scheme covers eggs, chicken, turkey, duck, dairy, pork, beef, lamb, salmon and a range of ready meals. It is meant to ensure that the worst industrial animal management practices are avoided, but it also does not address the use of GM feed.[17] Particularly as there is now considerable evidence that GM feed can cause serious health effects in animals, this is very disappointing. We urge the RSPCA to address the use of GM feed as soon as possible.

Despite dedicating resources to this, we found it difficult to establish the use of GM feed in the egg sector. Clearly the public, unless they read a review like this, have almost no access to useful information on GM feed use. We believe this shows how the lack of compulsory GM labelling of food for the use of GM feed is a major barrier to

3.6 Imported meat and dairy supplies for frozen and processed foods

A large proportion of UK food is frozen and processed foods, such as yoghurt, cheese, butter, ice cream and other dairy desserts, bacon, frozen meat, meat pies and other meat products. Frozen and processed foods are also used in convenience foods, catering and the take-away food sector. We have not specifically investigated the use of GM feed in these sectors, but they are probably mostly being produced from GM-fed animals.

While fresh meat and milk are largely produced within the UK, a large proportion of frozen and processed products are imported. For example, much of the processed chicken pieces sold in the UK are imported from countries like Thailand, frozen chicken is imported from Brazil, turkey from France, eggs from Spain and bacon from Denmark. Imported eggs are often used in powdered form for processing. Major users of imported processed chicken are high street take-away restaurants, such as Chinese take-aways.[19]

The supermarkets' non-GM feed policies do not generally apply outside the UK and there is little known commitment to non-GM feed in these countries. Overseas production is much harder to control because of the different producers, countries and conditions involved, and also because the supermarkets want the freedom of being able to change suppliers easily if costs or other conditions change (such as an outbreak of animal disease). Production is often more attractive in other countries precisely because of the freedom from 'European' concerns such as GM feed, so it is vitally important that this part of the UK food supply is not overlooked. In our view, this is an example of the loss of accountability and control that occurs with importing food, and a major reason for consumers (around the world) to buy nationally and preferably locally produced food as much as possible – it gives people so much more control over their food.

In the meantime, to address this discrepancy it is important to introduce compulsory EU-wide GM labelling for all foods from GM-fed animals, as this would apply to EU-produced and imported foods.

3.7 Organic sector feed

GMOs cannot be fed to organic livestock. This is enshrined in the European legislation on organic standards in accordance with the principles of organic farming: the use of natural biological processes and the concept of 'positive health'. 'Positive health' is about using good nutrition, based on organically grown crops and natural diets, and high welfare standards, to avoid the occurrence of animal health problems and to promote the quality of the food produced. This is instead of relying on the regular use of veterinary drugs for treating illness or routine prophylactic drug use, to prevent diseases spreading where the management conditions make disease inevitable, which is normal practice in industrial systems.

Livestock sold as organic must be reared according to the full organic standards throughout their life. In addition, their parents must have been managed to the full standards for a minimum period of three months for cattle and at least since mating for sheep. To produce certified organic milk, cattle must be managed to the organic standards for at least six months previously.

Under the standards, organic feed rations should, were possible, be entirely certified organic. However, because the sector is still developing and supplies of some organic feed protein sources are limited (maize and oilseed rape products), European organic standards currently allow organic farmers a limited use of certain non-organic feeds from non-GM sources if they are unavailable as organic. Under Soil Association standards, for all non-organic feed used, the farmer must obtain a written 'non-GM declaration' from the supplier and keep this, the delivery note and clear feed records available for checking at their annual inspection. Only certain 'approved' non-organic maize and oilseed rape products are permitted within the allowance. The list of these 'approved' non-organic feed ingredients is called Defra's 'Green List'.

These allowances are being steadily reduced as the organic sector develops. For organic ruminants, the current allowance for 5% of the total feed to be non-organic only lasts until the end of 2007; thereafter they must be fed only organic or 'in conversion' feeds (from farms in the process of converting to organic, and thus being managed under organic standards). For organic pigs and poultry, the allowance is 15% non-organic feed until the end of 2007, then 10% until the end of 2009, and then 5% until end 2011.[20]

The general use of organic feed, and the use of only non-GM sources for the non-organic maize and oilseed rape used, means GM material should not be present in feed fed to organic livestock. Nevertheless, many feedmills producing organic feed are also producing non-organic feed and there are risks of contamination earlier in the supply chain, so the risk of GM contamination has to be controlled and monitored.

Organic farming is a systems-based approach, based on the implementation of organic standards. The principal control method is regular inspection by organic certifiers, in which all aspects of the practices and records of the farms and processing operations are scrutinised in relation to the organic standards. Testing products is not a regular control method but it is used as a back-up to investigate suspect cases and to monitor the overall situation for certain issues. Therefore, in addition to its regular farm inspection programme, Soil Association Certification Ltd also does some GM testing of animal feeds.

Between April 2004 and 2006, Soil Association Certification Ltd carried out a programme of testing organic and non-organic feeds used on Soil Association certified farms. Eleven feeds were tested, eight compound feeds and three feed ingredients (two soya and one wheat feed). The compound feeds and wheat feed were all negative for GM above 0.1%. Only one sample, an 'approved' non-organic soya expellent, was positive: it was 0.3% GM. The company concerned was asked to improve monitoring of incoming materials. Since June 2006, non-organic soya products are no longer permitted in organic feeds. [21]

The organic sector has made progress in eliminating GM contamination. Earlier Soil Association Certification Ltd testing in 2002/2003 had found higher levels of GMOs. Eight samples from seven feedmills were tested (six compound feed samples and two soya samples). Four samples were positive: three were positive for GM soya and one for GM maize, with the GM levels ranging from 0.1% to 3.7%. After this, the Soil Association raised awareness of the issue among the feedmills and encouraged better controls. Soil Association Certification Ltd agreed to repeat the GM tests in the future.

There has been a similar experience within the Danish organic sector, with initial testing of animal feed finding frequent GM contamination, which then fell significantly after control measures were adopted.

3.8 GM feed labelling enforcement

Since 18 April 2004, according to EU legislation, if any quantity of the ingredients in animal feed are known by the feed producer to be GM or may contain GM material as they are not from a known non-GM source, they must be labelled as GM.[22] These labelling rules apply to both whole GMOs, containing GM protein and DNA, and derivatives (such as soya lecithin).

The only exception to this requirement is if the feed producer uses a non-GM source but some EU-approved GM material up to 0.9% of any ingredient is later found to be present due to "adventitious or technically unavoidable" contamination, to allow for unknown low level contamination. This allowance does not apply to unapproved GMOs, for which there is no legal tolerance.

This development is welcome, but whether it can be relied on by farmers to indicate GM presence depends on the authorities adequately enforcing the legislation. Unfortunately, this does not seem to be happening. Our research shows that no testing is being done by the UK authorities and a high level of GM feed is being sold unlabelled. 19% of our feed samples (seven of the 37) had no GM label but contained soya that was over 0.9% GM. The soya in five of these was over 80% GM. Worse, two were pure soya feeds made of 100% GM soya.

In the UK, the authorities responsible for implementing the GM labelling laws are Defra and the FSA. Actual enforcement of the legislation has been delegated to individual Local Food Authorities, in particular Environmental Health Officers and Trading Standards Officers, with Port Health Authorities usually responsible for controlling imported food.[23]

However, when in early 2005, the European Commission asked Defra and the FSA what controls were in place to enforce the GM labelling laws, they responded that "the majority of the checks are documentary checks" and there was "very little sampling and analysis due to the costs involved."[23] They said that no test results were available for 2004.[23] When we asked the FSA the same question in January 2006, we were told that no test results were available.[24] Given that the FSA claim that GMOs are "widely used" in animal feed,[25] the lack of regulatory control beyond paper trail checks is remarkable.

It should be noted, however, that the FSA's lack of testing is consistent with the European Commission's recommendations. Each year the Commission advises Member States on the focus of animal feed testing. As in previous years, its advice for the 2006 inspection programme did not include any testing for GMOs.[26]

The only GM feed testing which the FSA is known to have carried out was a four-week course of testing in 2005 for the presence of Bt10 maize, an illegal GM variety which Syngenta admitted had contaminated thousands of tonnes of a permitted GM maize, Bt11. This testing occurred a full six months after the US Government had alerted the British authorities.[27, 28]

There are long-standing concerns about the FSA's reluctance to control GM contamination, even of human food. This is part of a widely perceived pro-GM attitude that was highlighted by a review of the FSA's first five years.[29] The FSA's attitude is exemplified by the latest GM contamination scandal. In August 2006, the US Government revealed that an illegal and untested strain of GM rice (LL601) had contaminated US long-grain rice. Within four days, the European Commission banned US long grain rice imports and required all future imports to be tested and certified as free of the GMO.[30] The rice industry immediately began a programme of testing and rejecting contaminated lots.[31] They reported that tests in September found that about 20% of US long-grain rice in Europe was contaminated (33 of 162 samples). Friends of the Earth and Greenpeace also carried out tests of noodles and rice that identified presence of the illegal GM rice.[32]

In contrast, it emerged that the FSA privately told supermarkets on 5 September that it would not ask them to withdraw or test their long-grain rice, that they could continue selling the contaminated rice and that there were no safety concerns. This is despite the fact that they had no scientific evidence to know if the many known health risks with GMOs were absent in this variety. At the same time as the FSA was giving these private assurances, they were publicly saying "the presence of this GM material in rice on sale in the UK is illegal under European food law."[33,34] On 15 September, the European Food Safety Authority said that, based on a review of the available scientific evidence, it could not fully assess if the GM rice was safe.[35] The FSA changed its position only when Friends of the Earth initiated legal proceedings.[36]

4 Discussion – the extent of use of GM feed in the UK

Our findings suggest that, excluding feed for eggs and supermarket fresh poultrymeat, overall around 90% of UK animal feed contains GM ingredients, mainly GM soya and GM maize (either containing identifiable GM soya or containing maize or other soya ingredients which are highly likely to be GM), with around 70% containing GM soya. This is in line with the European feed industry estimate that 90% of compound feed produced in Europe contains some GM soya ingredients, and that, a few years ago, 95% of compounds feeds contained some GM ingredients.[1]

For the level of use of GM feed, the worst sector is the dairy sector, which is using soya that is around half GM and widely using GM maize, if our findings are accurate. The pig sector also seems to be using significant levels of GM soya, going by our finding that 20% of the soya in our samples was GM. The poultry sector is clearly operating to the highest standards in this area, as a result of the non-GM feed policy for supermarket own-label fresh poultrymeat and eggs.

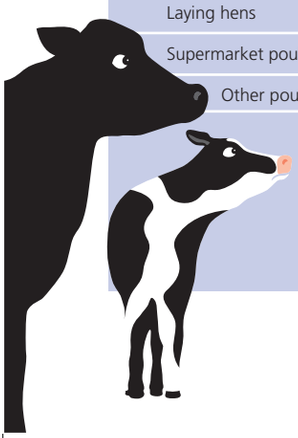
If our findings of the percentages of soya that are GM are representative for dairy, pigs and poultry nationally, then we can roughly estimate the overall percentage of UK animal feed that is GM and the amount of GM grain being used as animal feed in the UK, by weighting the percentages according to the different quantities of soya used by each sector. Excluding feed for supermarket poultry and for eggs, where non-GM feed policies apply, we estimate that around 30% of the soya used in UK manufactured feed for these three sectors is GM, or 14% overall for these sectors including supermarket poultrymeat and eggs (see table below). This includes compound feed manufactured by both the feed compound companies and the poultry integrators; it does not include feed for the red meat sectors or 'straight' feed used for home-mixing. We also estimate that around 145,733 tonnes of GM soya are being imported each year for the UK compound feed industry and poultry integrators. If the red meat sectors and home-mixing are included, this figure would be higher.

It is difficult to estimate the proportion of maize in animal feed that is GM. Any used by the poultry sector would have a low GM level, given that only around 15% of the poultrymeat sector and 33% of the egg sector is using feed containing GM material. However, it seems that little maize is used by the poultry sectors, compared to the other sectors. Our information from Defra for the early to mid-1990s was that compound feed for the poultry sector contained no maize, and maize gluten was mainly used for the dairy sectors where it made up 15% of compound feed, with a small amount used in pig feed, where it made up 2–4% of pig feed.[7] In our feed survey, the only samples containing maize were in the dairy sectors, where it was widely used, suggesting that the situation may be similar now.

Most of the maize used will contain some GM, with the level depending on the proportion coming from the US. 69% of maize gluten used in Europe's feed is imported from outside Europe[8] and mainly

Calculation of the amount of GM soya used in the UK

Sector	**Manufactured feed used,** Feb. 2006–07[2]	**% of feed that is soya**[3] (assumed)	**Quantity of soya used**, estimated [4]	**Assumed % soya that is GM** (from our research)	**Quantity of GM soya used**, estimated [5]
Dairy cattle	2,804,000t	3.3%	95,532t	51%	47,191t
Pigs	1,561,000t	15.5%	241,955t	20%	48,391t
Laying hens	1,125,000t	8.5%	95,625t	33% x 37%	11,676t
Supermarket poultrymeat	3,704,000t	15.9%	588,936t	0%	0
Other poultrymeat	654,000t	15.9%	103,986t	37%	38,475t
Overall	9,848,000t	11.4%	1,122,672t Excluding eggs & supermarket poultry meat: 438,111t	**14%**[6] Excluding eggs & supermarket poultrymeat: **30.6%**	**145,733t** Excluding eggs & supermarket poultry meat: 134,057tonnes



from the US, where it is produced by the wet-millers from unsegregated maize. We do not know what proportion of the non-GM maize in the US is sent to millers using segregation. However, if only half of the 39% of US maize that is non-GM is segregated (19.5%), that leaves 19.5% to be mixed with the 61% that is GM, suggesting an average of around 76% is actually GM. However, probably over 90% contains some GMOs.[9] The maize sourced within Europe, however, would be mostly non-GM. The six feed companies who gave information said they sourced maize from the US, except Hi Peak feeds (the specialist non-GM feed company) who sourced from France. Assuming that 69% of the maize gluten used in the UK is from the US and is 90% GM, while 31% is from Europe and all non-GM, this suggests that overall 62% of the maize used in the UK is GM (0.9×0.69). This would be an underestimate if a higher proportion comes from the US or a higher proportion is GM.

Applying the maize gluten inclusion rates of 15% for dairy feed and 3% for pigs to the figures for manufactured feed in the table, suggests the UK dairy sector is using 420,600t of maize gluten a year and the pig sector is using 46,830t a year from the compound feed industry. If 62% of this is GM, this means 290,000t of GM maize gluten are entering the country for the compound feed industry.

According to the feed companies, oilseed rape used in feed is from the UK or Europe, which suggests little use of GM oilseed rape.

As regards the amount of GM soya being used, the biggest concerns are in the dairy and pig sectors, which produce a range of basic foods: milk, cheese, yoghurt, pork, bacon and sausages, for example. Our inability to test feeds from many pig farmers producing on contract and from British Quality Pork means there is little transparency in the sector. As consumers cannot identify products from GM-fed animals by GM labels, this situation is unacceptable. People have a right to know how their food is being produced.

On the other hand, our findings that supermarket own-label fresh poultrymeat and eggs are nearly all produced from non-GM feed are highly welcome, particularly as these sectors account for two-thirds of the soya used as animal feed in the UK (see table). However, this does not, we believe, apply to imported poultrymeat and processed eggs, which means that much of frozen and processed poultry products in the supermarkets, and poultry and eggs used by restaurants and the catering trade, are probably produced with GM feed. So, although the UK poultry industry has made a very significant effort to use non-GM feed, the situation in the poultry sector nationally is not at all as good as it first appears. Moreover, the lack of transparency and independent verification of the non-GM feed used in the UK poultry sector, and the fact the non-GM policies do not apply to the whole UK sector, is unhelpful. It is not at all satisfactory that outside the supermarkets, consumers cannot be sure which chicken or eggs have been produced with non-GM feed. The poultry industry should address these issues to enable consumers to buy UK poultrymeat and eggs with confidence and for the industry to reap the benefit of their valued efforts in being mostly non-GM.

The apparently general lack of non-GM feed policies among the supermarkets and compound feed companies, outside Marks & Spencers and the poultry sector, is disappointing. This is particularly the case for quality and ethical food labels such as Freedom Foods, where we believe the public would be very surprised and disappointed to find out that GM feed may be being used. We also regret the lack of any non-GM feed requirements by the basic industry standards, the Little Red Tractor and Lion eggs.

We are disappointed with farmers' markets. The number of these have been growing fast. We believe their success is partially based on the fact that consumers believe that by buying fresh food direct from farmers, they can have more trust in the production and quality of the foods and avoid the most industrial practices promoted by the economic power and competitiveness of the supermarkets and agricultural corporations. However, farmers' markets are weaker on GMOs than the supermarkets, as chicken and, to a lesser extent, eggs sold at farmers' markets may have been produced with GM feed. Other popular products at these markets, such as cheese, pork, and bacon will also probably have been produced with GM feed, unless the farmer specifies otherwise. Each market sets its policy in accordance with the rules of FARMA, the certifier for farmers' markets. The current FARMA rules state, "Markets should, for the time being, include a policy that no GMOs are knowingly sold or included in products sold at market."[10] The fact there is no reference to the use of non-GM feed is a major oversight which should be addressed.

The organic sector is important in providing a food option that the public and catering companies can always count on being produced without the use of GM feed or GM ingredients, as this is a condition of organic farming. Organic milk, eggs, meat and other dairy products are now widely available in the supermarkets, independent and specialist shops, farmers' markets and through some mail-order schemes.

5 The animal health effects of GM feed

The widespread use of GM material in animal feed raises the questions of whether any GM material ends up in the food we consume (any of the GM DNA or novel proteins produced by the modified crop plant), and whether the use of GM feed has negative health impacts on the animals.

New scientific evidence has emerged over the last couple of years that has substantially changed our understanding. Evidence is beginning to emerge that if GM feed is used, small amounts of GM material may indeed end up in food even if this is not always identified. There is also now a worrying body of published, peer-reviewed scientific evidence from studies carried out in many countries and by different parties (government, independent and company studies) that feeding GMOs to animals does in fact cause a wide range of serious unexpected health impacts in a substantial number of cases. Both of these issues raise serious animal and human health and welfare concerns and also major ethical concerns about the fact that foods from GM-fed animals remain unlabelled. The findings also raise serious questions about the adequacy of the European safety assessment and advisory procedures.

5.1 Do milk, eggs and meat from GM-fed animals contain GM material?

It was often suggested by the advocates of GM crops that there should be no concerns about this issue because GM crop material is degraded during processing into feed and during digestion. (There are, for instance, significant secretions of nucleases, enzymes which break down DNA, along the gut.)[1] Until a couple of years ago, none of the published studies had detected transgenic (GM) DNA in the milk, eggs or meat of GM-fed animals.[2,3,4,5]

Nevertheless, several of these studies found that plant chloroplast DNA from animal feed is present in milk, eggs and meat.[2,3,4] This plant DNA was not nuclear DNA, the DNA contained in the nuclei of cells which is where the novel genes ('trangenes') are usually inserted for making GM crops. It was instead the DNA that is found in the chloroplasts, the plant 'organelles' that photosynthesise and which are present in large numbers in plant cells. Chloroplast DNA is vastly more abundant than nuclear DNA, since each plant cell can have thousands of copies of chloroplast genes but just two to four copies of each nuclear gene. Plant chloroplast DNA is therefore thought to be more detectable in animal products than nuclear DNA simply because of its greater abundance, not because it is less susceptible to breakdown during processing or digestion.

It is therefore in fact likely that many studies were failing to detect GM crop ('transgenic') DNA in animal products and tissues because of its comparatively low level of presence and limitations in the sensitivity of the analytic methods being used, rather than because transgenic DNA does not actually make its way into animal products and tissues.

Since late 2005, however, three published studies by three different scientific teams and one unpublished study have actually detected transgenic plant DNA in animal tissues and milk.

A Canadian team fed pigs and sheep Roundup Ready oilseed rape and then examined various tissues from the animals. They found that a liver, a kidney and intestinal tissues from the pigs, and intestinal tissues from the sheep contained fractions of the transgenes.[6] In another study, Italian scientists fed piglets for 35 days on Monsanto's GM maize (Mon 810). They subsequently found fragments of a transgene in the blood, liver, spleen and kidney of the animals.[7]

Another Italian research team, from the University of Catania, detected GM soya and GM sequences in shop-bought milk in Italy.[8] An unpublished study, carried out in the year 2000 at the University of Weihenstephan in Germany, also detected GM material (from GM soya and GM maize) in the milk of cows which had been fed large amounts of GM plants. The results of the study were published by Greenpeace in 2004.[9,10] The researcher has suggested that the DNA may have been a result of contamination of the milk by dust from the GM feed in the dairy. Whilst this is unproven, this points to a potential common source of contamination with the use of GM feed and does not change or undermine the fact that the researcher found GM DNA in the milk.

The Soil Association decided to also investigate this issue. We asked those farmers whose feeds we had found contained high levels of GM soya, if they would also provide samples of their milk or eggs for testing for the presence of GM DNA or GM protein. Two dairy farmers and one egg producer agreed to provide samples. Each farmer provided two samples of milk (from two different cows) or two samples of eggs, as well as another sample of feed to re-check the GM soya level. All samples were tested by Genetic ID in Germany. The soya in all three feed samples was found to be 100% GM. However, our tests did not detect any GM DNA or protein in any of the milk or egg samples. In several of the milk samples, plant DNA, including soya DNA, was detected, indicating the possibility that a very low level of undetected GM DNA may have been present. Subsequently, when we became aware of the Italian research which had detected GM DNA in shop-bought milk, we also carried out a similar, but smaller-scale survey. Milk samples were collected from 10 different leading supermarket or corner shop chains. All of the samples were analysed using the same analytic technique used by the scientists from Catania, as well as by an in-house method. Again, no GM DNA or protein was detected, but several samples contained traces of plant DNA, including soya DNA.

In conclusion, based on the fact that crop chloroplast DNA is commonly found in milk, eggs and animal tissues, and that four research teams now have, between them, detected GM crop DNA in the milk, blood, liver, kidneys and intestinal tissues of GM-fed animals, we conclude that it is likely that people are being frequently exposed to GM DNA by eating milk and meat from GM-fed animals, albeit at very low levels. Further research into this subject is needed.

5.2 Does GM feed affect the health of animals?

Biotechnology companies have claimed that genetic engineering is no more unpredictable and dangerous than traditional cross-breeding, and as a result GM crops should not be subjected to special or extensive safety assessments. In reality, genetic modification differs fundamentally from traditional cross-breeding, and there are very good scientific reasons for being concerned about the safety of GM crops.

Genetic engineering usually involves introducing a package of genetic material derived from one organism (or several) into the DNA of another, often a completely different species. It is never based on the plant's normal reproductive processes, which are used in traditional cross-breeding. Instead, the foreign DNA is inserted into the plant's own DNA either by using the infective process of a disease bacteria or by bombarding the cells with fine metal particles coated with the foreign DNA. This artificial DNA insertion breaks down the natural biological mechanisms that normally maintain the genetic integrity of species. At various stages in the process, the number of cells are increased by a laboratory method called a "tissue culture".

The technique has several serious flaws. This means there is a large number of risks inherent in GM crops, which do not apply to plants produced by traditional cross-breeding:

- Since the inserted genes usually come from other organisms such as bacteria or are synthetically produced, the proteins they produce are often new to the animal or human diet. The production of the protein may also involve a new biochemical pathway in the plant or affect an existing one, which can mean the production of other novel protein or biochemical by-products, some of which could be allergenic or toxic. This explains why GMOs have been associated with allergic reactions.
- The technique is highly disruptive to the plant's genes in various ways. The process of inserting the gene is known to damage the plant's own DNA: the gene can integrate right in the middle of another gene, causing it to lose its function.[11] Additionally, the tissue culture stages cause numerous changes to the rest of the plant's DNA. There is well-documented evidence by the FSA and others that genetic engineering causes extensive 'genome-wide' mutations and changes in the activity of very many of the plant's own genes as a result of genetic engineering.[12] These widespread genetic effects are not predictable or controllable.
- Unlike naturally occurring genes which are generally only active at certain times and in certain cells, transgenes are usually active the whole time and

in all cells. This means that the gene's products and any by-products are present in all of the plant's tissues. So, for example, unlike normal non-GM maize, the Bt toxin is present in all the cells in Bt maize, the main GM maize used in animal feed.

- It is now known that genes do not operate in isolation or completely dictate to the plant, contrary to the earlier simple scientific concept of genes as building blocks and the 'blueprint' of life. Genes are instead themselves controlled by numerous interactive plant regulatory mechanisms, including other genes and cellular processes, in a complex system which is far from fully understood (the science of 'epigenetics'). The result is that the same gene can behave in 10 different ways in 10 different locations, depending on the regulatory elements it ends up next to.[11] As genetic engineers cannot control where the genes end up in the plant DNA and do not know the effects of the different locations, unpredicted side effects easily occur.
- Scientists have recently found that a harmless protein in one organism can become harmful when inserted into another organism, even if its sequence of amino acids remains completely identical. This is because of a process called "post-translation modification" whereby, depending on the plant species and the type of cell, different sugars, lipids or other molecules attach to the protein and modify its function (an example is 'glycosylation'). This was recently highlighted by Australian scientists who inserted a previously harmless bean protein into a pea, which then caused allergic reactions in mice.[13,14,15] Genetic engineers are unable to accurately predict and control this effect.
- Research commissioned by the FSA and others, on both humans and animals, has now shown that the inserted transgenes can move out of GMOs when they are eaten and enter the bacterial population in the mouth and gut, a process known as 'horizontal gene transfer'.[16,17] There are concerns that this means that there may be instances when, over time, the gut bacteria start to produce the transgenic protein in the animal or human gut, such as antibiotic resistance or Bt toxin production, with health implications.
- The inserted gene is often unstable and, over time, found to rearrange within the plant's genome. In 2003, a French laboratory analysed the inserted genes in five GM varieties, including Monsanto's Roundup Ready soya, and found that in all cases the genetic sequences were different to those that had been described years earlier by the biotechnology companies.[18,19] Subsequently, a Belgian research group also found differences to the companies' genetic sequences, as well as to those found by the French scientists.[19,20] This genetic instability means that the way in which the inserted gene expresses itself in the plant and its impacts on health may change over time.

Official safety assessments are far too narrow

One of the most remarkable facts about the development of GM crops is that, despite years of immense public concern, political controversy and the developing scientific understanding of the risks of GMOs, very few of these risks are actually checked in the official regulatory approval process. There is a long regulatory process that requires the companies to submit considerable amounts of information, but almost none except a small sub-set of the above concerns are routinely investigated in the process.

Those opposed to GM crops generally believe that any overall assessment of the list of risks indicates that GM crops are currently far too risky to be used for animal feed or food. Governments, however, have been persuaded to allow GM crops to be grown and used for food or animal feed as long as there is a 'case-by-case' risk assessment. The problem is that the impacts of the genetic engineering process on the biology of organisms is so complex, and scientific knowledge of plant biochemistry so limited, that it is completely impossible for scientists to model and predict the actual health effects of each genetic engineering attempt. The only way that the risks listed above could be assessed on a case-by-case basis, with some level of accuracy, would be to use animal feeding trials. This is how the safety of medical drugs and pesticides are assessed. However, the biotechnology companies are not normally required to undertake such animal feeding trials in Europe, the US, or indeed anywhere. Although this was the initial intention of the UK and US Governments, the use of animal feeding trials for risk assessment was quickly abandoned after the first of such trials, on GM tomatoes and potatoes, found unexpected adverse effects on the animals (see later).

Instead, regulators mainly rely on an assessment process that is much more limited. Under this approach (commonly referred to as 'substantial equivalence'), a limited number of comparisons are made with the non-GM equivalent plant. Several of the physical characteristics of the new GM plant are compared with the non-GM variety. Then, a chemical comparison is made. But, although plants have up to 10,000 different biochemicals, the levels of only a small number of the GM plant's biochemicals are checked with the non-GM plant, such as key nutrients and known toxins. If the levels of these are considered 'similar', it is then assumed that the whole chemistry of the GM plant is similar as regards safety in almost every other way. The GM crop is considered 'substantially equivalent' to the non-GM plant, and no further special safety tests have to be carried out. The OECD, for example, suggested that ,"If a new food or food component is found to be substantially equivalent to an existing food or food component, it can be treated in the same manner with respect to safety".[21]

Under the EU assessment procedure, some other checks are required beyond this basic comparison, but the 'substantial equivalence' approach still rules. So, the EU usually requires testing to show whether the protein produced by the gene is toxic or allergenic. However, the safety of all the other novel proteins and biochemical by-products produced by the GMO are not usually checked. The stability of the inserted gene has to be checked, but not the stability of the whole genome and thus not the GMO as a whole. These other aspects are essentially just assumed, without any basis, to be safe. No GMO has ever been rejected under this assessment process.

Ever since 'substantial equivalence' was first proposed by the US Government for approving GM crops, there has been strong criticism of this process as fundamentally unscientific and inadequate for safety assessment. In 1992, when the US Government proposed using the concept instead of animal trials, the scientific advisers of the US Food and Drug Administration's (FDA) did not support the Government's policy, arguing that animal feeding trials were needed to identify undesirable effects.[22] The policy was adopted anyway and then taken up by Europe and other countries. In 2001, a review for the Canadian Government by the Royal Society of Canada concluded that, "The Panel finds the use of 'substantial equivalence' as a decision threshold tool to exempt GM agricultural products from rigorous scientific assessment to be scientifically unjustifiable."[23] Other scientists, writing in the eminent scientific journal *Nature* have described substantial equivalence as "a pseudo-scientific concept" which is inherently "anti-scientific because it was created primarily to provide an excuse for not requiring biochemical or toxicological tests". They point out that scientists are not able to reliably predict the effects of a GM food from knowledge of its chemical composition, and so active investigation of the safety and toxicity of GM crops is required.[24] Even the former Chair of the FSA's advisory committee, the Advisory Committee on Novel Foods and Processes (ACNFP), which until 2004 was responsible for carrying out safety assessments of GM foods, has said, "The presumption of safety of novel GM plants on the basis of substantial equivalence lacks scientific credibility."[25]

Poor safety assessment of Roundup Ready soya

Monsanto's Roundup Ready soya (RR soya) is the most widely grown GM crop variety in the world and the most widely detected GM crop in commercial animal feed. Its safety assessment is therefore of particular interest. 'Roundup Ready' soya varieties tolerate applications of Monsanto's 'broad spectrum' glyphosate herbicide, Roundup, which destroys all other plants. The summary of the safety data used in the regulatory approval process is available from Monsanto's website.[26] It does not, however, make for reassuring reading for it shows that Monsanto's scientific case is very flimsy.

The new protein which the genetic modification had introduced to the soya was compared with other proteins already in the food chain, and deemed to be 'functionally similar'. Its amino-acid sequence was compared with known protein toxins and allergens, and found to be different. Monsanto then claimed that 'compositional analyses' established that the GM soya (as a whole) was substantially equivalent to the non-GM parent variety and other soya varieties.

The safety of the novel protein was assessed only in one short-term (acute) feeding trial with mice. The safety of the protein was not tested on any of the species that are now actually eating the novel protein in animal feed. The only feeding tests carried out with the soya were 'nutritional' feeding studies, which assessed growth rate in a variety of animals

and milk production in dairy cows. No animal feeding studies were carried out which were specifically designed to determine the safety of the whole GM soya; in particular no toxicological tests were done. No long-term feeding studies were carried out.

In the absence of such basic scientific investigations, it is clear that no objective assessment of Monsanto's evidence could conclude that the safety of RR soya has been determined.

Animal feeding tests show negative effects of GM crops

The biotechnology companies frequently refer to the large number of published animal feeding studies as evidence of the safety of GM feed. However, it is important to stress that the vast majority of these are not safety studies. They are not toxicological studies, which would involve analysing the animal tissue for toxic effects, or studies of other safety aspects such as the rate of horizontal gene transfer. Instead, these studies are mostly of commercial interest, designed to evaluate the effect of the GM crops on commercial feed performance indicators, such as livestock growth rates or milk production. In contrast, if we look at the much smaller number of genuine animal safety studies, some of which were conducted by the companies themselves, a very different and very worrying picture emerges. We summarise below the alarming findings that have now accumulated for the GM crops being used as animal feed.

(i) GM soya

Russian rat trial – A Russian scientist, Dr Irina Ermakova, investigated the effects of feeding Roundup Ready soya to rats, with dramatic findings of apparent generational effects. A group of female rats were fed RR soya before mating, during pregnancy and during lactation. Very high mortality rates occurred in the rat pups: 56% died within three weeks of birth, compared with only 9% in the control rats fed non-GM soya. Additionally, stunted growth was observed in the surviving progeny, with some of the organs in the smaller GM-fed pups being tiny in comparison with those from control groups.[27] This study has now been published.[28] Dr Ermakova was shocked by her own results and has called for further detailed investigations to be undertaken.[29]

(The ACNFP reviewed an early draft of Ermakova's work and said it lacked detail, in particular about the geographical origins of the GM and non-GM soya used and whether they contained mycotoxins, and said no conclusions could be drawn.[30] They also claimed that her results were inconsistent with another feeding trial of RR soya which had not found any adverse effects.[31] The ACNFP's comments are seen as biased, however, as the latter study was not a valid comparison since it used male mice, not pregnant rats, and, while the ACNFP called this study "well controlled", it had less nutritional detail than Ermakova's study.[32])

Italian mouse trial – One of the only long-term feeding studies carried out on GM crops was undertaken by scientists from Urbino, in Italy, and found that Roundup Ready soya affects key body organs. Mice were fed RR soya for up to 24 months. A variety of organs and body fluids were then examined. The scientists found significant cellular changes in the liver, pancreas and testes of mice, which involved structural changes and/or functional changes.[33,34,35,36,37] The cellular changes in the liver, which metabolises toxic compounds, suggested that RR soya causes an increased metabolic rate.

FSA human feeding trial – The only published trial of GM foods on humans was carried out by Newcastle University for the Food Standards Agency, and published in 2004. It was designed to study what happens to transgenic DNA in the human gut and whether it could pass out and enter bacteria in the body, a long-standing concern. It found that the entire transgenic gene in GM soya survives the passage through the stomach and small intestine, though not through the colon. The study also discovered that portions of transgenic DNA had 'horizontally' transferred from GM food into the intestinal bacteria of some of the volunteers, which was a shocking discovery with implications for the long-term impacts of GM consumption.[16,38] Just as shocking, however, was the fact that at the time the FSA chose not to mention this key finding in its communications on the study, thus widely giving the impression that horizontal gene transfer had not been identified in the study.

(ii) GM maize

Monsanto rat trial – In June 2005, after a German court ruling in favour of Greenpeace, Monsanto was forced to release the full details of its safety data for the GM maize, MON 863, which was being evaluated by the European Food Safety Authority (EFSA). The maize had been genetically modified to produce a Bt-toxin which kills the corn rootworm, a maize pest. Monsanto's studies showed that the Bt maize had several statistically significant effects on the rats: increased white blood cells, a drop in immature red blood cells, decreased kidney weight and increased blood sugar levels.[39,40]

The chemical data also showed signs of toxic effects to the liver and kidney systems. Professor Gilles-Eric Séralini, a molecular endocrinologist and member of two French government commissions that evaluate GM food, said that the rats likely suffered a toxic reaction. A full analysis of the chemical data by Professor Séralini and his team was published in May 2007. It states, "with the present data it cannot be concluded that GM corn MON 863 is a safe product".[41]

The EFSA GMO Panel, nonetheless, recommended the GM maize should be approved, accepting Monsanto arguments as to why the statistically significant differences should be ignored. (The Panel has been accused of being pro-GM and having financial links to the industry. For example, according to Friends of the Earth, two of its members have appeared in industry videos promoting biotechnology).[40,42] Despite the EFSA's endorsement, the EU's Council of Ministers voted to not approve the GM maize. However, the vote required a 'qualified majority'. This was not achieved, so the Commission had the final say. It approved MON 863 on the basis of the 'scientific advice' of the GMO Panel, in January 2006.[40,43]

Aventis's chicken and rat trials – Aventis (since purchased by Bayer) carried out two controversial feeding trials of its herbicide-tolerant Chardon 'Liberty Link' (T25) maize, which it submitted for approval at the end of 1995. In a 42-day feeding trial with chickens, there was a 7% mortality rate for chickens fed the T25 maize, twice the rate of the non-GM fed chickens (10 of 140 died versus five of 140 of those fed non-GM maize). Compositional tests revealed a significant difference in the level of fats and carbohydrate between the GM and non-GM maize, suggesting alterations in some biochemical pathways.[44]

Separately, Aventis also tested just the transgenic PAT protein which is produced by the modified maize and which gives resistance to the company's herbicide, glufosinate. In a short-term, 14-day rat feeding study, the effects of the isolated protein were tested on four groups of rats, two of which were fed the PAT protein, one at a low level and one at a high level.

The design of the studies meant that any negative effects that occurred would be obscured, unless they were very dramatic: only five male and five female rats were tested in each group (restricting the chance of establishing statistical significance for any effects), the starting weights varied by +/-20% (rather than the usual +/-2%), and the group receiving the high level of the transgenic PAT protein had the highest starting body weights. Despite this, and the fact that the high PAT protein group showed the highest feed intake, this group ended up with the lowest body weights, significantly less than the group receiving the equivalent non-GM diet and the group receiving the low level of PAT protein. Biochemical differences and measurements of the urine volume indicated an increased metabolic load on the rats fed the PAT protein.[44]

Despite this opposing scientific evidence, T25 maize was approved for consumption by the EU in April 1998. Liberty Link GM maize has been widely marketed in North America by Bayer Crop-Science.

UK study of gene transfer in sheep – A UK study with sheep, published in 2003, found that when GM maize was eaten, after only eight minutes, some of the inserted transgenes moved out from the maize and 'horizontally' transferred into the bacteria in the mouth. One of the inserted genes coded for resistance to the antibiotic kanamycin.

After the transgenes transferred, the *E.coli* bacteria were found to be resistant to the antibiotic, showing that the transgenes had integrated into the bacteria's own DNA. This proved that 'horizontal gene transfer' of inserted genes can happen relatively easily.[17]

(iii) GM oilseed rape

Monsanto rat trials – The GM oilseed rape, GT73, has been approved in Europe since 2004, although documentation published by the US FDA shows that two of Monsanto's rat feeding studies found statistically significant adverse effects.[45] GT73 is a glyphosate-tolerant 'Roundup Ready' (RR)variety.

The first study, carried out with a mixture of two of Monsanto's glyphosate-tolerant oilseed rape varieties, including GT73, found statistically significant decreases in terminal body weight and cumulative body weight gains in male rats (but not female rats) fed GM rape, compared to rats fed non-GM rape. Monsanto, however, argued that there were 'technical' problems with the study, and repeated it. Interestingly, while the US FDA clearly states that statistically significant differences in the body weights of the male rats were found, the EFSA claimed that the study found no differences in body weights (though they admitted that the GM-fed rats had higher liver to body weight ratios).[46]

The second study, conducted solely with the GT73 variety, found that rats fed this GM rape had relative liver weights that were increased up to 16% compared to those fed the non-GM parental line. Apparently forgetting that there had been 'technical' problems with the first study and that the rats had not been fed exactly the same GM rape in both studies, Monsanto argued that the results of the second study should also be ignored since the results of the two trials were 'inconsistent'. They carried out a third study which did not find any problems.[45] In August 2004, GT73 was approved for food and feed use in the EU.

(iv) GM peas

Australian mice trial – The results of recently published research by Australian scientists on the safety of GM peas raises serious questions about the safety of GM crops in general. The researchers inserted a gene, normally found in kidney beans, to peas to make them resistant to the pea weavil, and then fed the GM peas to mice for four weeks. The peas triggered allergic reactions in the mice: the lung tissue became inflamed. The mice also became sensitive to other substances, reacting to egg white, whereas those fed non-GM peas did not. Even after cooking the peas, the mice still had an allergic reaction.[13,14,15]

This was considered a surprising result as the mice did not have an allergic reaction to non-GM peas or to the kidney beans, and because the new protein being expressed by the introduced gene in the peas was chemically identical to the protein in the kidney beans. Closer examination, however, revealed that although the protein in the GM peas had an identical amino acid sequence to the protein in beans, there were now differences in the sugars attached to it (due to glycosylation).

The scientists concluded that "transgenic expression of non-native proteins in plants may lead to the synthesis of structural variants possessing altered immunogenicity".[13] In other words, a protein which is non-toxic in its native plant cannot be assumed to remain non-toxic when transferred and expressed in a GM plant– yet this is precisely what has been assumed by regulators so far. The 'substantial equivalence' approach does not assess the possibility of such harmful glycosylation occurring.

(v) GM tomatoes

Calgene mice trials – Unpublished trials with GM Flavr Savr tomatoes commissioned by the company Calgene and submitted to the US FDA in order to gain approval for the first GM food, found that mice fed the tomatoes developed lesions in the gut wall. In a 28-day trial, groups of 40 rats were fed GM tomato or a control diet.

Out of 20 female rats fed the GM tomato, lesions were identified in four and seven rats, by two expert groups respectively. No such effects were found in the control rats. The FDA requested another study to be carried out. Lesions occurred again (2 of 15 rats) and, additionally, seven out of 40 (17.5%) of the rats fed the GM tomatoes died within two weeks.[47] Following this, the biotechnology industry and US Government agreed to instead use the 'substantial equivalence' concept for approving GM crops, rather than animal feeding trials. Calgene's Flavr Savr tomato and Zeneca's similar GM tomato variety were approved by the FDA in mid-1994. Both varieties were also cleared for sale in the UK, although only Zeneca's (then AstraZeneca) product was sold, as tomato paste until June 1999.

(vi) GM potatoes

UK rat trials – Similar results to GM tomatoes were found by the first animal feeding trial in the UK, and with the same consequence. GM potatoes were famously found to cause lesions in the gut wall of rats in a controlled trial by Dr Arpad Pusztai, working at the Rowett Research Institute in Scotland. The findings, which were publicised in 1998, caused major controversy and misinformation was widely spread by proponents of GM crops that the trials had not been controlled.

Pusztai's studies had been commissioned by the UK Government in order to develop a protocol for using animal feeding trials for the risk assessment of GM crops, so the findings should have been taken very seriously. Instead, Pusztai was suspended, gagged, and eventually lost his job. The UK Government abandoned its plan to require animal feeding trials and instead followed the US Government's policy of relying primarily on 'substantial equivalence'. Pusztai's study was published in the Lancet medical journal, [48] which recommended that it be repeated. To this day, this has not been done.

6 Reducing GM animal feed use

Securing the UK's non-GM soya and maize supplies

The supermarkets and feed companies have in the past raised a number of difficulties in using non-GM feed. One problem cited has been that there are inadequate supplies of non-GM feed, and in particular reliable sources of non-GM feed. However, this is clearly not true. The amount of non-GM soya available in Brazil is enormous: in this year, 2007, around 30 million tonnes is non-GM, 16 times as much soya as the UK imports. Moreover, the amount of soya available that is certified non-GM is also far more than the UK needs: for instance, over six times the amount the UK imports was available certified as non-GM from the soya suppliers certified by just one of the certifying companies (Cert ID) in 2006.[1]

Although some feed industry contacts told us they were finding that non-GM supplies were getting tighter, this may be a reflection of the availability with their current suppliers. The specialised non-GM certifying companies are clear that there are no difficulties in sourcing non-GM soya and the certified amount expands to fit demand. Cert ID confirmed again, in 2007, that non-GM soya is "abundant" and any fears over shortages are not supported by the actual availability.[2] Non-GM maize should also be easily available: in the US, twice as much non-GM maize is being grown as the UK imports and there are numerous elevators using segregation, which could supply processors in the UK. Non-GM maize can also be obtained within Europe, and there is significant potential for increasing production. Furthermore, if proof were needed, the consistent success over many years of the poultry sector, by far the largest user of soya feed in the UK, in sourcing non-GM feed shows that there is no serious problem with securing adequate supplies.

A regular objection by the feed industry and supermarkets is over the additional costs, that farmers cannot afford even small increases in their costs, and the feed companies and farmers complain that the supermarkets will not pay the necessary extra cost. For example, in its *Corporate Responsibility Review 2006*, Tesco says that, "The farming community has told us that to extend the range of meat we sell from animals fed on non-GM would put immense pressure on them." We fully agree that farmers should not foot the bill; this should be paid for by the supermarkets and if necessary reflected in the cost of food. This is clearly a very important barrier for many of the feed companies, and the supermarkets need to take responsibility in this area.

Cost should not be a major problem for the supermarkets, as the cost of using non-GM feed, as a percentage of total retail costs, is extremely small. It has been estimated that for pigs, with a non-GM soya premium of 3.6%, the increase in costs at the retail end would be only 1p per kg for pork or 1.8p per kg for bacon. For milk, a non-GM feed premium of 3.7% would mean a tiny increase in the retail cost of milk of 0.17p per litre.[3] Again, if further proof were needed, the fact that the supermarkets and poultry industry have accepted the cost for poultrymeat and eggs, and with little publicity to reap economic benefits from this, shows that cost is not an insurmountable obstacle. If costs are increasing, this is presumably due to the growing pressure from the GM soya area in Brazil which may mean that non-GM supplies through regular soya sources are becoming more difficult to obtain. Certified sources are more expensive but there is no shortage at the moment through this supply, and the overall cost to the supermarkets is still minimal.

Consideration of why the poultry sector has led the industry in the use of non-GM feed suggests that in fact the main obstacle may be nothing to do with the supply or cost of non-GM feed, but may be due to differences in the supply chains. The poultry sector is controlled by a few large companies, the integrators, and these are both the suppliers of the supermarkets or other food companies, and also the main feed manufacturers. This means that the supermarkets have much more control over the feed in this sector than, say in the dairy sector, where there are two stages between the supermarkets and the feed companies (the dairies and the farmers).

Additionally, the whole bird-rearing stage is done by a single farmer, not divided between farmers. There are some integrators in the pig sector as well, but there are two rearing stages done by farmers, often with different farmers rearing and 'finishing' the pigs (fattening them). So it is harder to control the whole feed used as not only do the farmers supplying the integrator or supermarket have to use non-GM feed, but the farmers they buy their pigs from have to be required to as well. Beef production is even more

complicated, with three production stages sometimes carried out by different farmers, and also many individual farmers rather than integrators. The dairy sector involves thousands of individual farmers. However, there is a small number of dairy companies which control the whole sector. While the use of feed in the beef sector may be more difficult to control, the dairy companies do not have this excuse and should be using their full organisational and economic power to require the general use of non-GM feed by all their milk suppliers.

However, we cannot accept that there really are insurmountable obstacles to requiring the use of non-GM feed in even the pig and beef sectors. Most of the supermarkets already have various requirements for their suppliers, such as welfare conditions for their livestock suppliers. A requirement that their livestock suppliers must use certified non-GM feed sources, and (importantly) a small price increase by the supermarkets, should surely address this issue quickly and efficiently. Especially for the dairies and pig integrators, it should be easy for them to ensure compliance, through their contract specifications and checking their suppliers' certification documentation. Alternatively, the basic industry Farm Assurance standards already incorporate a number of requirements and have an enforcement system in place, with inspections. As most commercial livestock production already adheres to these standards, they could easily be amended to introduce industry-wide requirements for the use of non-GM feed and ensure compliance.

Another objection raised by the feed companies, is that if the UK livestock industry uses non-GM feed, then they will be putting themselves at a competitive disadvantage with livestock producers in other countries, which have already cornered a large portion of the frozen and processed meat products market. Though the cost of using non-GM feed is small in terms of the final retail food price, this is clearly a concern for the feed companies. It is also vital from the public's point of view that non-GM feed policies cover imported food. It is therefore essential that the supermarkets impose, and pay for, the same requirements for non-GM feed use on their overseas suppliers as on their domestic suppliers. Nevertheless, the obviously greater difficulty with influencing and guaranteeing the production of imports highlights the need for compulsory GM labelling of products from GM-fed animals. This would not only greatly help the supermarkets to incorporate imported food into their non-GM feed policies, but would enable consumers to make informed choices about all food they buy in the shops, not just own-label supermarket produce.

The only remaining concern is over the future security of non-GM soya supplies from Brazil. Brazil is currently the only large non-GM soya exporter, but more and more farmers there are being tempted to try GM varieties. The concern is that as more farmers in more regions grow GM varieties, the areas supplying GM-free soya will decrease, making it harder to source not just non-GM soya for animals but even to maintain the non-GM soya ingredient supplies for the UK food industry, which essentially depends on the soya being bought for feed. Therefore, decisions being made in Brazil about future soya plantings have a major impact on the future availability of non-GM food and feed in Europe.

A limitation of the influence of the UK market, however, is that it is only a small part of the market for Brazilian soya exports. However, Europe as a whole is one of the main markets for Brazilian soya and there is demand for non-GM feed throughout Europe, not just in the UK. Sweden has for a long time had a mainly non-GM feed policy, supported by its agricultural sector, and at least two other countries have recently taken steps to significantly reduce the use of GM feed. In March, the Polish Government announced it would ban GM feed within two years unless there is scientific evidence to prove that it is safe. Then in June, the new coalition Government in Ireland decided to move towards making the whole of Ireland GM-free. Discussions have already been held between the main farmers organisations on voluntarily phasing out GM feed.[4] There are apparently also some reports from Italy and France that their markets are increasingly requiring the use of non-GM feed.[5]

Discussions with the feed and soya industry suggest that another main barrier to securing the area of non-GM soya in Brazil for the future is the shortage of orders for certified non-GM soya. It is one thing for the feed industry to source from Brazil on the grounds that it is currently a reliable non-GM supplier, but it is another for the industry specifically to order certified non-GM soya from Brazil and thus communicate to the Brazilian traders and farmers that the maintenance of Brazil's non-GM soya supply is commercially important. The feed companies therefore need to demand guaranteed non-GM supplies for all the sectors, not just part of the poultry sector. This should be done

with the use of certified IP soya: this is independently certified as being both from a non-GM source and segregated along the supply chain, with testing, to ensure it is GM-free.

Interestingly, in their response, Waitrose said that one reason for their hesitation in using more non-GM soya was their concern over contributing to the deforestation of the Amazon, by promoting the expansion of soya. This was not the first time we heard this. This is a dramatic but surely unfounded concern. It is well known that there is an enormous production of non-GM soya already being produced in Brazil. The proportion of this that is channelled into the non-GM soya supply chain, rather than being mixed with the GM soya, depends solely on the demand for certified non-GM soya, which the supermarkets can determine through their specifications. The expansion of the soya area into the Amazon is the result of the overall expansion of the use of soya and due mainly to the expansion of industrial poultry and pig production in Brazil, China and other Asian countries. These countries are not generally demanding non-GM soya feed.[6]

The answer then lies heavily with the supermarkets. If the supermarkets insist that all the meat and milk they sell must come from animals raised on certified GM-free feeds by the middle of next year, and pay the necessary difference to the farmers, integrators and dairies, then a larger guaranteed market for Brazilian farmers for non-GM soya would be rapidly created, thus helping to guarantee longer-term supplies for the UK.

British retailers have already responded to calls from environmental organisations to protect future supplies of non-GM soya from Brazil. Although they have yet to take the most important action of requiring and paying for their suppliers to use only certified non-GM soya, they have awoken to the threat of non-GM soya supplies disappearing. They have urged the Brazilian soya industry to halt the expansion of GM soya, saying: "It will be enormously difficult to maintain trust in the food chain should Brazil's supply of non-GM soybean dry up. It is therefore essential that Brazil remains a continued source of non-GM soybean and halts the progression at the current level of 35% GM. We urge the Brazilian industry to resist further growth of GM planting."[7]

As for maize, non-GM supplies should also be widely available and are far more secure. Unlike soya, the majority of world production remains non-GM. Already, 31% of maize used in Europe is sourced within Europe and nearly all of this is non-GM. Moreover, there is huge potential for increased production in Eastern Europe. Non-GM maize grain supplies can also be sourced from the US, and processed into non-GM maize gluten by the UK processors. Already, the total US non-GM maize is over double the UK's needs, and there are readily accessible market mechanisms in place to provide this non-GM maize and increase supplies: a quarter of the US maize elevators offers segregated non-GM maize with half paying premiums to the farmers.[8] Therefore, increasing demand for non-GM maize would translate into increased supplies.

However, it seems unlikely that the current US maize gluten suppliers can provide non-GM supplies. US non-GM maize gluten comes from the wet-millers and it seems unlikely they will turn to non-GM maize on any significant scale for the time-being. Their main markets are the food processing and paper industries, neither of which are going to be at the front of the queue to use non-GM maize. Then, the use of maize for wet-milling for industrial uses is now increasing due to the massive US Government and industry investment in biofuels, which is using maize as the raw material. This is diverting millions of tonnes of US maize away from food and feed use. This will not reduce US maize gluten exports, as maize for ethanol also uses the wet-milling process and produces maize gluten as a by-product.[9] In fact, the increased production of maize ethanol may increase the supply or competitiveness of US maize gluten. Given this, the development of maize supplies from other countries that do not grow GM crops appears all the more important.

Overall, we believe that the supermarkets, dairies, pigmeat suppliers and feed industry need to engage much more actively and transparently with this issue, in line with consumer views. It is excellent that the industry has established the FEMAS non-GM IP scheme. However, apart from the poultry sector, the food and feed industry has shied away from using this and the other industry opportunities to provide non-GM feed. At an international level, the feed industry may have been swayed by the propaganda of the biotechnology sector. Faced with the possibility of a future plant protein shortage if the current expansion of livestock farming continues, the International Feed Industry Federation (IFIF) has been hoping that genetic engineering may help deliver greater future production. The Secretary General of the IFIF has called for the feed industry to join the GM debate to convince consumers to be open to GM crops.[10] However, there is no scientific reason to expect GM crop to deliver increases in feed

yields (grain yield is determined by the interaction of many genes, management and climate, but genetic engineering can only modify a few single genes and with often deleterious side-effects on overall yield or plant health). The feed industry leaders need to take a more realistic and market-orientated position, recognise their responsibility in this area and respond positively to public concerns.

We also urge the largest food companies with the greatest power in determining the national use of GM feed, like British Quality Pork, the dairies, Bernard Matthews, Deans Foods, Northern Foods, Allied Bakeries, and Costco to require only certified non-GM feed to be used by their farmer suppliers and be fully transparent about their feed policies. Companies operating in the hospitality and catering sectors, like hotels and the catering company 3663, should also review their sourcing policies, and ensure they are requiring all their meat and dairy supplies to be from non-GM fed animals.

Finally, the organisations responsible for setting the standards for quality and ethical food labels, such as 'free-range' egg production and the RSPCA's 'Freedom Foods' range, and farmers' markets, should recognise the importance of this issue and consider the public's ethical expectations of their labels. They should take a public lead in requiring the use of non-GM feed in their standards.

Farmers can buy non-GM feed

Our finding that around 90% of manufactured feeds contain GM ingredients, besides the feed used in the poultry sector, contrasts with the finding by ADAS in 2004 that only 26% of non-organic farmers would consider feeding GM products to their livestock.[11] This indicates that the low level of awareness among farmers of the presence of GM feed is part of reason for the wide use of GM feed, and that farmers may reduce their use significantly if they become more aware of the issue.

As all GM feed ingredients must now be labelled, simply checking the label should now tell a farmer whether the feed he/she is using is GM or not. However, as we have reported, our testing of animal feed samples has shown that feed containing soya which is not labelled as GM frequently contains high levels of GM soya. There may also be unlabelled GM maize material in the feed. So even if the label doesn't say it is GM, it might still be GM. The risk is high for soya, maize and vegetable oil, but relatively low for oilseed rape. The best thing is to contact the feed company and ask.

On the other hand, if the ingredients are labelled "non-GM" (0.1%)', this means that the company has used a non-GM source and the level of any contamination should be below 0.1%. If the ingredients are labelled "Identity Preserved" (or IP), then this means that the ingredients are certified non-GM, which means there is the guarantee of a certifying third party.

It is easy to buy non-GM feeds. As well as the company Grain Harvesters, which had supplied one of the farmers in our feed survey with guaranteed non-GM feed, our responses from some of the major feed companies (see 3.2) has shown that many feed companies offer non-GM feeds on demand, such as: BOCM Pauls, ABNA, Carrs Billington, NWF, Grampian and Farnway. The difference in cost depends solely on the level of the ingredients. For example, for high soya feeds, the companies have told us that the premium is £3–5/tonne. As always, it is good practice to phone around and get the best price.

It is best to buy certified IP non-GM feed. Certification of IP systems provides a much higher level of confidence that the ingredients are actually GM-free. The certification companies are independent and actively carry out testing of the ingredients to ensure there is no contamination above a low maximum level (usually 0.1%). Most importantly, however, the certification mechanism plays an important role in the marketplace in communicating the demand for non-GM feed back to the producers, thus helping to secure non-GM supplies for the future.

Farmers should ask their feed company to provide certified non-GM ingredients, such as through the FEMAS or SGS or from the non-GM suppliers certified by Cert ID, or they could consider using feeds that do not contain ingredients from crops that can be GM. If their main feed company contacts cannot help, there are some feed specialist companies, such as Hi Peak Feeds, who only supply non-GM feed and use certified IP ingredients where relevant. Alternatively, farmers could choose to use organic feed, where they can be sure they are using non-GM feed, or they could mix their own feed using home-grown ingredients.

Growing home-produced feed

The concerns over imported GM feeds and securing non-GM soya supplies can be seen as an important opportunity for British farmers to grow and buy more UK animal feed crops, increasing the feed market for British farmers and reducing UK agriculture's reliance on imports.

A variety of home-grown crops could be used instead of soya and maize. All of these would avoid the issue of GM feed, as there are no commercial GM varieties so even GM contamination is not a concern. Peas and beans are already widely used as sources of protein (peas contain approximately 25% protein and beans 26–30%). Forage peas can also be a valuable source of protein in ruminant crops.[12] Helpfully, home-grown peas and beans are eligible for a 55.57 Euros/ha subsidy under the protein crop premium, on top of the single farm payment.[13] (Oilseeds, having previously been eligible for support under the old Arable Area Payment Scheme, no longer receive an additional subsidy.)

One of the most promising crops yet to be fully developed commercially are lupins: the grain of this legume contains high levels of protein (32–40%), making it a very credible alternative to soya, particularly in ruminant feed. For pigs and poultry, the relatively low levels of the amino acid, lysine, mean that diets would need to be supplemented by another protein source. Lupins were traditionally unpalatable to animals because of high levels of alkaloids, but modern varieties have very low alkaloid concentrations. They do, however, require a long growing season and so spring-sown varieties do not ripen early enough. The development of winter-hardy varieties has made successful cultivation in the UK possible. Lupins also have the advantage of high levels of nitrogen fixation, so that nitrogen fertiliser is not required. In Australia, lupins are already increasingly used to replace soya meal and fishmeal in animal feed, but in the UK only about 2,000 hectares were grown in 2001.[12,14,15]

A variety of oilseed crops, other than oilseed rape, can also be grown in the UK. Linseed has high levels of protein (35–38% protein in linseed meal) and has much lower nitrogen requirements than oilseed rape.[12,14] Hemp seed meal contains over 30% protein, and recent trials feeding hemp seed meal to egg-laying hens found that egg production did not fall and the eggs contained lower levels of saturated fats and higher levels of omega-3 and omega-6 fatty acids.[16] Crambe, a close relative of mustard and kale (it is also called Abyssinian kale) produces meal containing 25–30% protein and has been suggested as a source of animal feed.[12,17]

A number of legume forages also have the potential to increase the quantity of home-grown protein: lucerne, red and white clover, sainfoin and birdsfoot trefoil.[12,14] Recent increases in the prices of nitrogen fertiliser are beginning to change the economics of growing such crops, which have the ability to fix their own nitrogen from the air. Predicted continuing increases in natural gas prices in the coming years is expected to push the cost of nitrogen fertiliser higher still, and make these crops increasingly attractive.

It has been calculated that, in the UK, the cheapest protein (in terms of variable cost of crude protein) is from forage crops.[18] For arable crops, lupins provide the cheapest protein followed by peas and beans, whereas oilseed rape is considerably more expensive. The success of oilseed rape as a feed ingredient has been attributed to its greater overall profitability and consistent yield performance.

Reducing meat consumption to lower demand for grain protein

As stated in Chapter 2, the worldwide consumption of meat, milk and eggs has greatly increased in recent decades and is expected to keep increasing in future years. Animal protein has been estimated to now provide about 35% of the protein in the human diet, with 70% of animal protein coming from ruminants.[12] However, for every kg of high-quality animal protein produced, livestock are fed around 6kg of plant protein.[19] This means that as animal products become more important in the human diet, total demand for plant protein is increased, and this plant protein has generally been soya protein.

This is particularly true for 'white' meat from non-ruminant livestock, pigs and poultry, which require high levels of grain. Ruminant animals (cattle and sheep), because of their ability to digest cellulose, can be productive and obtain all their energy and protein needs just from grass pasture and forage. Indeed this is generally more natural and healthier for them. The modern move towards greater consumption of white meats, with the fall in cost due to factory farming methods, has therefore greatly intensified the need for grain for animal feed. Globally, in 2002, poultry feeds accounted for the greatest overall proportion of tonnage of manufactured feeds, followed by pig feeds and then dairy feeds.[20]

This means that consumers could play their part in reducing the use of GM feed, by reducing their overall consumption of meat, and non-organic white meat in particular. This would reduce the demand for soya imports and the amount of GM crops being used to produce our food, as well as increasing the possibility that UK farmers will be able to grow all the feed they need here. The reduction of factory-farmed white meat would also bring major animal welfare benefits.

Labelling of food produced from GM-fed animals

Our investigation into the use of GM feed has led us to conclude that it is very important that GM labelling legislation is extended to cover products from GM-fed animals. Currently, consumers have no information when buying most meat and dairy products whether they might have been produced with GM feed. Because of the lack of food labelling, we had to do this special investigation with testing and surveys of feed company and supermarket policies, to be able to inform the public. However, we were still unable to directly find out the level of use of GM maize in the feed industry and were unable to verify the use of non-GM feed in the poultrymeat sector and from the main pig supplier, due to the refusal of the companies. Our research could also not cover the feed used for imported meat and dairy products, a major omission.

It seems very wrong that information cannot be readily ascertained for something so important regarding the production of our food. In addition, we are aware that many UK feed company and supermarket policies on non-GM feed are only addressing UK produced food, and the feed companies are hesitant to use more expensive non-GM feed and reduce their competitiveness with importers. We therefore strongly recommend that European-wide compulsory GM labelling is extended to products from GM-fed animals, which would then address home-produced and imported food equally, to enable consumers to make choices and to influence the use of GM feed.

The findings of GM material in the tissue of animals provides a clear rationale for labelling foodstuffs from animals fed on GM feeds. Currently, according to the EU labelling laws for GM food and GM feeds, foods from animals fed GM feed do not need to be labelled. This is because the "determining criterion is whether or not material derived from the genetically modified source material is present in the food or in the feed."[21] Since the latest scientific evidence shows that GM material is present in some meat and dairy foods, albeit at low levels, the EU and Governments should now require that these foods be labelled.

There is very strong public support for such labelling of foods from GM-fed animals and growing political support. A recent EU-wide petition organised by Greenpeace gathered a million signatures and was delivered to the European Commission in February 2007. The EU Health Commissioner Markos Kyprianou said the petition, "shows a strong interest on the part of European citizens … and therefore we will take this into serious consideration."[22] An NOP survey carried out for Friends of the Earth in 2006 found that 87% of the UK public think that foods from animals fed on a GM diet should be labelled.[23] This confirms the findings of a survey by the National Consumer Council in 2001, which found that 79% of the UK public believe meat and other products from animals fed GM fed should be labelled, after which the NCC called on the FSA to introduce such labelling requirements.[24]

In November 2006, the Conservative Party tabled an Early Day Motion in the House of Commons, to gather all party support for labelling foods from GM-fed animals. As of June 2007, this had been signed by 131 MPs. The full text is:

"That this House understands the public concern caused by the development of genetically modified organisms, notes with concern that proper husbandry guidelines to prevent cross-contamination are still lacking in this country; believes that consumers have the right to choose non-GM food and that all foods containing GM material, or that come from livestock fed on GM, should be clearly labelled as such; further notes that it is scientifically established that the presence of GM can be traced down to, or close to, 0.1 per cent. and believes that this should be the trigger point for GM labelling; and calls on the Government to ban any commercial planting of GM crops until or unless the science shows that this would be safe for people and the environment, and until or unless issues of liability and crop segregation are resolved."[25]

7 Conclusions

Nearly all the meat and dairy foods sold in UK supermarkets are now being produced from GMOs and being sold to the public without labels, with the exception of organic foods and most fresh own-label poultrymeat and eggs. On average, excluding feed for the poultry sector, about 90% of manufactured animal feed is now GM, containing either GM soya or GM maize. Very large quantities of GMOs are being imported into the UK as animal feed, including by our calculation approximately 146,000 tonnes of GM soya and 290,000 tonnes of GM maize gluten annually for the feed compounders and poultry integrators in these sectors (and more if home-mixing and the red meat sectors are included). Around 30% of the soya being used by the UK feed industry, apart from feed for eggs and supermarket fresh poultrymeat, is GM. An even higher proportion, perhaps around 60%, of the maize used by the industry is GM.

The worst sectors in terms of percentage of GM crops, are the dairy and pig sectors. The dairy sector is using soya that is around 50% GM and widely using maize estimated to be 60% GM. The pig sector uses a far higher level of soya for feed and the level that is GM appears to be significant (20% in our samples). The best sectors are poultrymeat and eggs, where around 85% and an estimated two-thirds of the feed is non-GM, respectively, based on our findings. Nevertheless, the recent abandonment of the blanket non-GM feed policy of Noble Foods for its battery eggs is a disappointment and the industry is urged to recommit to using non-GM feed.

There is even more concern about the use of GM feed outside the supermarkets' own-label food. Although we did not investigate this specifically, the indications are that as well as much of the meat and milk, much poultrymeat and eggs used for other brands, and used in processing and catering, are also produced with GM feed. It is excellent that nearly all 'free-range' and 'barn' eggs are produced with non-GM feed. Nevertheless, it is worrying that ethical food labels like 'free-range' eggs and Freedom Foods are allowing the use of GM feed in principle, which means that the public cannot reliably choose non-GM products just by selecting these labels. Currently the only food label that means non-use of GM feed is 'organic'.

As well as the unpalatable and worrying fact that GM crops are now being used to produce our food without public knowledge, this British feed market (and that of other countries) is also supporting the expansion of GM crops around the world and putting at risk the continued exclusion of GM ingredients in our food. We believe the public would be shocked to know all this has been happening without their knowledge.

There is a surprisingly low level of awareness among farmers about their use of GM feed. At least 59% of livestock farmers are unaware whether they are using GM feed, although three-quarters of feed is now labelled as GM. The absence of a GM label, however, is currently not a reliable indication that feeds are not GM, as we found around 19% of feeds contain high levels of GM ingredients but are not labelled, in contravention of EU law. This poor compliance with the legislation shows that the Food Standards Agency must start to take effective action in this area if it is to enable farmer and consumer choice in the use of GM feed, and also if it is to have public confidence in its willingness to regulate GMOs.

There are concerns that the public may be being exposed to low levels of GM material in their food through this use of GM feed. There are also major concerns about the animal health and welfare impacts of using GM feed based on a growing number of scientific trials which are finding various adverse effects in animals from consuming GM feed.

We greatly welcome and applaud the leadership of Marks & Spencer in supplying a range of milk, eggs and fresh meat products from non-GM fed animals. We also strongly welcome the efforts by supermarkets and the poultry industry as regards the poultrymeat and egg sectors. These are very significant achievements. We call for other supermarkets and livestock sectors to follow the example of Marks & Spencer and the supermarket poultry sectors in using non-GM feed.

The supermarkets and food companies all need to also dramatically improve the quality of their communications with the public on this issue. Overall, our investigation – both our findings and the difficulties encountered – highlights the fact that there is a very serious lack of transparency by the industry over the use of non-GM feed, and that the public currently has a very limited ability to make informed choices and directly influence the market in this area. This shows the great importance of extending EU labelling rules to cover foods from non-GM fed animals, an option supported by most of the public. Although it has made a great

effort, the poultry industry should also address its lack of consistency on the use of non-GM feed, which is making it confusing for consumers wishing to make informed choices.

Securing the UK's future supply of non-GM soya is essential – soya is not only used to produce most of our milk and dairy products, but it is also used in 60% of all processed foods. However, it is the feed industry that determines the availability of non-GM soya. There is currently more than enough non-GM soya production to supply the UK many times over. However, with the current expansion of GM varieties in Brazil, securing non-GM soya production in Brazil is essential to ensure a reliable, viable non-GM soya supply into the future. With the decisions on soya planting in Brazil taking place in the autumn, the UK food and feed industry should act now, to make substantial progress away from GM feed next year.

The Soil Association urges the food industry and public to take the following actions:

- Supermarkets, other food retailers and food manufacturers: to require and pay for all their meat and dairy suppliers to use only certified non-GM feeds by the middle of next year for all their fresh, frozen and processed meat and dairy foods; and meanwhile to label all their foods that are produced with GM feed so they are being honest with their customers.
- Those setting standards for food labels like 'Freedom Foods' and 'free range', basic industry marques like 'The Little Red Tractor' and 'Lion eggs', and the largest food companies with the greatest power to determine the GM content of UK animal feed (like the major dairy companies and BQP, the largest pig producer) should insist on the use of only certified non-GM feeds and in the meantime be fully transparent about their feed policies in their communications.
- Farmers should check with their feed supplier if their feed is GM and order only certified non-GM feed, and where possible move to growing or sourcing UK-grown feed.
- Animal feed companies should from now on use only certified IP non-GM soya, from 'sustainable soya' sources for all their feed; maize too should come from non-GM sources.
- All consumers who care about this should ask their supermarket, favourite food companies, restaurants and farmers' market to use only non-GM fed animals, and meanwhile buy only:

Milk – from Marks & Spencer, Sainsbury's 'Farm Promise' milk or organic milk

Eggs – any own-label supermarket eggs except from Iceland; the egg brands, 'Woodland, 'Corn Gold', 'Columbus omega-3 rich', and 'Church and Manor' duck eggs; for other brands and eggs in independent retailers, only eggs actually labelled as produced without GM feed; or organic eggs

Chicken and turkey – any supermarket own-label fresh meat except from Iceland; frozen own-label chicken in Sainsbury's and Morrisons; frozen own-label turkey in Morrisons; Lloyd Maunder products (in some supermarkets and butchers); or organic meat

Pork, beef and lamb – fresh meat from Marks & Spencer; beef- or pork-containing products in Sainsbury's 'Taste the Difference' range; lamb or beef that is labelled as only fed on grass; or organic meat

Processed meat and dairy products – organic is the only known general non-GM option for processed meat and dairy products, such as yoghurt, cheese, butter, cream, ice cream, frozen meat, bacon, ham, sausages, meat pies, corned beef, and ready meals.

Notes

The tests were as accurate and comprehensive as possible, comprising tests for the presence of markers as general screens (such as the 35S promoter and the NOS terminator), and also tests for 'species specific reference genes', to identify specific GM varieties.

Each feed sample was tested for:

- Roundup Ready soya
- 10 varieties of GM maize including Bt176, Mon 810, Bt11 and illegal varieties such as StarLink
- and three types of GM oilseed rape.

The test results have the following margins of error, all with a confidence of 95%:

- for results below 0.15%, +/-80%
- for results 0.15% - 0.5%, +/-70%
- for results above 0.5%, +/-40%.

This means that the results do not convey the exact level of GM material in each specific case.

DNQ = GM soya detected but non-quantifiable, ie. the quantity is less than 0.1%. In this report, these are treated as if no GM material were found.

Feeds from the same farm are denoted with the same number but different letters.

Appendices

Appendix I Detailed results of the Soil Association's feed testing programme

A) Test results for dairy cattle feed

Farm sample	Feed company	Compound feed or soya	Which ingredients labelled as 'GM'	% of soya found to be GM	Whether farmer knew feed was GM
1	Carrs Billington	Compound	Vegetable oils, distillers dark grains	DNQ	Said feed is GM
2	Mole Valley Farmers	Compound	Soya, maize	0.5%	Thinks GM-free
3	Heygates & Sons	Compound	Soya	72%	Didn't know
4	Stobart & Sons	Compound	Maize	DNQ	Didn't know
5	NWF	Compound	Soya, maize	100%	Didn't know
6	Mole Valley Farmers	Compound	Soya, maize	100%	Didn't know
7	KW Alternative Feeds	Compound	Soya, maize	23%	Thought GM
8	(local shipper)	Soya	–	100%	Probably contains GM
9	Davidson Brothers	Compound	Illegible ingredients list	DNQ	Didn't know
10	Massey Bros	Compound	Maize	100%	Didn't know
11	BOCM Pauls	Compound	Soya, maize	13%	Didn't know
12	Carrs Billington	Compound	Soya, maize	6%	Didn't know
13	Carrs Billington	Compound	Maize	DNQ	Didn't know

B) Test results for pig feed

Farm sample	Feed company	Compound feed or soya	Which ingredients labelled as 'GM'	% of soya found to be GM	Whether farmer knew feed was GM
1	Scotts of Omagh	Compound	Rapeseed	4%	Didn't know
2	BOCM Pauls	Compound	Vegetable oils	DNQ	Didn't know
3	Stephenson's Animal Feeds	Compound	Company provided no ingredients list	96%	Didn't know
4	Ballinaskeagh Grains Ltd	Soya	–	100%	Didn't know
5a	BOCM Pauls	Compound	–	DNQ	Didn't know
5b	BOCM Pauls	Compound	Soya, vegetable oils	6%	Didn't know
5c	BOCM Pauls	Compound	–	DNQ	Didn't know
5d	BOCM Pauls	Compound	Soya, vegetable oils	23%	Didn't know
5e	BOCM Pauls	Compound	Soya, vegetable oils	4%	Didn't know
6	BOCM Pauls	Compound	Vegetable oils	4%	Probably GM
7a	ABN	Compound	Soya, vegetable oils	0.2%	Said non-GM
7b	BOCM Pauls	Compound	Soya	21%	Said GM
7c	ABN	Compound	Soya, vegetable oils	0.3%	Said non-GM
7d	BOCM Pauls	Compound	Vegetable oils	1.2%	Said non-GM
8	ABN	Compound	Soya	DNQ	Didn't know
9	Cargills	Soya	Soya	0%	Didn't know

C) Test results for poultry feed

Farm sample	Feed company	Compound feed or soya	Which ingredients labelled as 'GM'	% of soya found to be GM	Whether farmer knew feed was GM
Broiler 1	ABN	Compound	No ingredients list provided	100%	Said GM (wants non-GM)
Turkey 1	Grain Harvesters	Compound	–	0%	Didn't know
Turkey 2a	BOCM Pauls	Compound	–	14%	Didn't know
Turkey 2b	BOCM Pauls	Compound	–	81%	Didn't know
Layer 1	ABN	Compound	Soya	32%	Didn't know
Layer 2	ABN	Compound	Soya, vegetable oil	1.9%	Didn't know
Layer 3	BOCM Pauls	Compound	Soya, vegetable oils	0.2%	Said GM (wants non-GM)
Layer 4	Farmway	Soya	Soya	70%	Didn't know

Appendix II Glossary

Battery eggs/systems – intensive industrial systems of caged egg production, a form of 'factory farming'. The chickens are kept in cages with sloping mesh floors, so that the eggs roll forward and out of the cages onto boards or belts for removal. The minimum space required by law is 550cm^2 per bird. The houses are kept at even temperatures, with ventilation and electric lighting. Since 2003, under EU legislation, all new caged egg farms must provide 750cm^2 per bird, as well as a nest, perching space and scratching area – 'enriched cages'. From 2012, all production in non-enriched cages will be illegal throughout Europe (although the UK has been pushing for an extension to 2017).

Broiler – a chicken (male or female) that has been selectively bred and reared for meat rather than eggs.

Bt – the soil bacteria, *Bacillus thuringiensis*, which produces an insecticidal toxin. There are many types of Bt toxin. Some crops, in particular maize, have been genetically engineered to continuously produce a type of Bt toxin – 'Bt crops'; there are some concerns over the safety of this GM crop for feed or food use.

Caged eggs/birds – this includes eggs from conventional battery systems and so-called 'enriched cages' – see 'battery eggs'. Caged systems are the most common method of commercial egg production in the UK. 63% of UK eggs were produced in caged systems in 2006.

Compound feed – feeds that are mixtures of two or more feed materials. They are often blends of various raw materials and additives, and often formulated according to the requirements of the customer, based on the livestock's needs (depending on the species, age, whether the livestock is for milk or meat production). They are usually produced in dedicated feedmills by a feed company, and often supplied in pellet form. Authorised additives in compounds feeds include vitamins, binders, trace elements and preservatives.

Concentrate – the term for a high protein/energy feed substance.

Dairy products – generally defined as foods produced from milk, such as butter, cheese, cream and yoghurt. This is the definition that is mostly used in this report. It is sometimes used more loosely to include other food products produced from farm animals (other than meat), in particular eggs. 'Dairy farmers', however, means exclusively farmers owning dairy cattle and producing milk.

Elevator – the first destination for harvested grain crops in North America, where they are cleaned and sorted before being taken to processing plants.

Food Standard Agency – the UK body responsible for advising the Government and public on the safety and approval of GMOs and other food additives and practices; it reports to Parliament rather than to ministers.

Free range – a term used to describe livestock management systems in which the animals range outdoors, or, legally, which at least provide the animals access to the outdoors. It is applied particularly to chicken and pig production, as commercial production of these is otherwise often in intensive indoor systems. There is EU legislation governing the use of the term 'free range' for chickens, but not for pigs.

The basic legislation requires egg-laying birds to have continuous daytime access to open-air runs, and meat birds (broilers) to have continuous daytime access to open-air runs for at least half their lives. 'Free-range' broilers must be at least eight weeks old when they are slaughtered, so the outdoor period is typically four weeks. The outdoor area must be at least $4m^2$/bird for egg laying birds and $1m^2$/bird for meat birds, and mainly covered by vegetation. There is no upper limit on the flock size under the basic legislation. However, if eggs are to be marketed as 'free range' under the Lion code in the UK, then a maximum flock size of 6,000 chickens applies and the outdoor space must be at least $10m^2$ per bird. Current 'free-range' chicken systems therefore vary in size and character and include many almost industrial units with many thousands of birds of modern fast-growing breeds in one shed, with pop-holes for outdoor access. This is particularly the case for 'free-range' chickens being reared for meat. Under such systems, some or many of the birds may spend little of their time outdoors.

All organic farming is free range. The basic UK standards for outdoor access for organic poultry are similar to non-organic 'free range', but in addition the pasture must be organic and rested for two months after each batch of laying hens or for two months each year where the land is used for meat birds. Soil Association standards are far stricter: flocks sizes must be no more than 2,000 for laying birds and 1,000 for meat birds; meat birds must be ranging for at least two-thirds of their life (as they must live at least 80 days, this is around eight weeks); the outdoor area must be at least $10m^2$/bird for laying hens and $4m^2$/bird for meat birds; and the pasture must be rested for at least nine months after each batch of laying hens and for an additional one year in three for meat birds (as well as the two months per year). This ensures that the birds really do spend their lives roaming outdoors and avoids the build up of disease and parasites.

Genetic engineering – a process by which the genetic make-up, and thus the characteristics, of an organism is altered artificially, usually by inserting specific sequences of DNA into the organism's own DNA. It is completely different to natural reproductive processes and gives rise to numerous unpredictable and uncontrollable changes in the rest of the plant's genes, and thus in the plant's overall biochemistry. Often DNA is used from a different species with which normal breeding would be impossible.

GM – genetically modified. GM, genetically engineered, or transgenic are all terms that describe an organism that has undergone genetic engineering.

GMO – genetically modified organism.

GM-free – not produced from GMOs and free of any GM material or substances derived from GMOs, including GM contamination. It is not the same as non-GM, which sometimes may have a low level of unintentional GM content, due to contamination.

Integrators – agri-businesses that own and manage more than one stage of the industrial production chain, and are thus involved in processing and marketing, as well as controlling the agricultural production stage. It is generally done through production contracts between the processor and the farmers, but the integrator company may also own and manage part or all of the farming. The company may produce its own compound feed in its own feedmill and even supply the chicks/piglets to the farmers. This system is particularly a feature of the poultry industry, not just in the UK but the globally. This business model results from very competitive price pressure forcing lower production costs and demand for quantity and consistency of supply from large buyers, which pushes the processors to seek both more control over the production stage and economies of scale.

IP – Identity Preserved. A process of managing seed, crops, food, feed or other products to guarantee the integrity of the final product with respect to the original ingredients, for example to guarantee that the product is not contaminated with GMOs. It typically involves the use of non-GM seed, segregated processing facilities, the cleaning of equipment between GM and non-GM lots, GM testing, record-keeping, and independent auditing. IP

systems are used by manufacturers and retailers to sell non-GM produce.

Layer – a chicken that has been bred and reared for egg laying.

Meal – the edible part of any grain ground to powder. Soya meal is what is produced from soya beans after the beans are dehulled, crushed and the soya oil has been extracted.

Non-GM – non-GM does not necessarily mean totally GM-free, but refers to crops or feeds that are meant to be only of plant varieties that have not been genetically modified, but which have or may have a low level of GMOs present by contamination (usually below 0.9% or 0.1%), because measures have not been taken to avoid the risks of contamination where such risks exist or because the ability of measures to avoid contamination are limited in practice.

Organic – organic farming is an approach that was developed early last century. It is based on a set of principles and practices based on observations of the relationship between soil biological health, farming practices and the health of livestock and humans. The objectives of organic farming are environmentally sustainable farming that delivers optimally healthy food and high animal welfare. It involves the harnessing of natural biological and ecological processes through farm management techniques, rather than the use of artificial chemicals or artificial interventions in natural biology. The basic approach and practices were formalised in standards which have now been set down in EU legislation (Council Regulation 2092/91, as amended) and in similar legislation in other countries. Food cannot be sold as 'organic' unless it has been produced in accordance with the organic standards, and producers must be registered with a government-accredited organic certifier (such as the Soil Association). The standards cover all aspects of food production. Organic standards relevant to this report include the prohibition on the use of GMOs and that most of the animal feed must be organically produced (at least 95% of ruminant feed and at least 85% of poultry feed, with no GMOs in the non-organic part; these percentages are being increased as the supply of organic feed grows). About 4% of UK farmers are now organic. Organic food is growing in popularity. The UK organic food market is now worth over £1.9 billion and increasing by over 20% a year.

Own-label – or own-brand, refers to products produced and marketed under the supermarkets name and sold only in that supermarket, rather than being a product from an independent company which may be sold in many shops. For instance, Sainsbury's may sell its own-label baked beans, labelled "Sainsbury's", but may also sell one or more brands of baked beans such as Heinz; the supermarkets will sell their own-label eggs but also brands such as Big and Fresh, owned by Noble Foods. The supermarkets have full control over the ingredients and production of their own-label products, but no direct control over the brands, other than whether to stock them or not and at what price.

Roundup Ready (RR) – crops that have been genetically engineered to be tolerant to Roundup, Monsanto's brand name for its glyphosate herbicide.

Substantially equivalent – a term used by regulators and biotechnology companies to describe GM crops that have similar levels of a limited number of chemicals, usually key nutrients and toxins, and similar physical characteristics, to their non-GM counter-parts and are as a consequence considered otherwise similar to the non-GM crops by regulatory authorities. This approach forms the basis for the approval regime for GMOs and has been heavily criticised for its inability to determine the complete biochemical safety of GMOs and for its use as a replacement to full safety testing with animal feeding trials.

Traceability – the ability to trace and follow a food, feed, food-producing animal or substance through all stages of production, processing and distribution.

Transgenic – genetically modified. See 'GM'. Transgenes refers to the foreign genes inserted into a GM organism.

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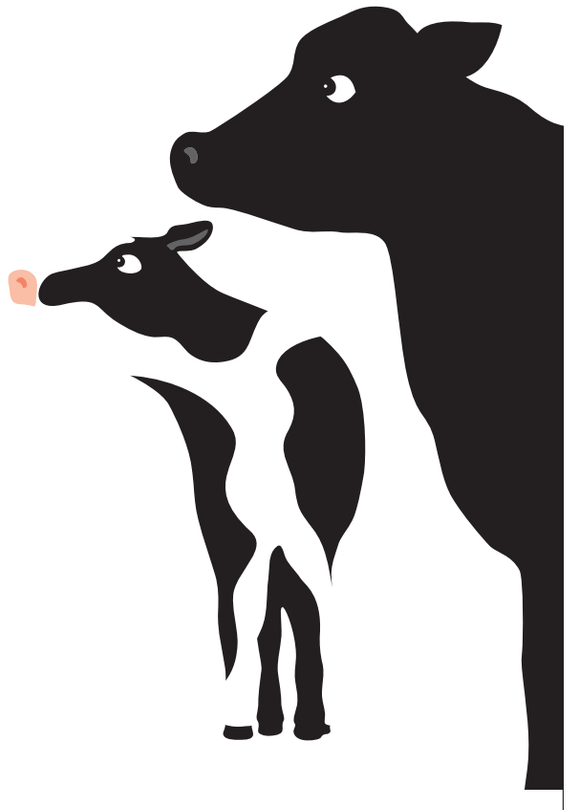

Acknowledgements

Researched by Cóilín Nunan, with assistance from Kathleen Hewlett.

Written by Gundula Azeez and Cóilín Nunan.

With many thanks to all the farmers who supplied samples and answered our questions; BOCM Pauls and the other feed companies who provided information, Deans Foods, the British Free Range Egg Producers Association and the supermarkets for their helpful information; and Genetic ID for testing the samples.

Thank you to Peter Melchett and Elizabeth Winkler for commenting on the drafts of the report.

Produced by the Soil Association (layout by Fiona Russell, cover by E & P, proofing by Anna Groves). Printed by Wells Printing Services, ISO 14001 environmental accredited on Take 2 Offset 100% recycled post-consumer waste.

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The Soil Association is the UK's leading environmental charity campaigning for a global shift to sustainable, organic food and farming practices.

Founded in 1946 by a far-sighted group of farmers, doctors and concerned citizens, the organisation is dedicated to bringing about change by creating a growing body of public opinion that understands the direct link between farming practice and plant, animal, human and environmental health.

Today the Soil Association is an internationally respected authority on sustainable agriculture and recognised champion of healthy food, which uniquely represents and offers practical solutions to everyone involved in the food chain – farmers, food processors, retailers and consumers.

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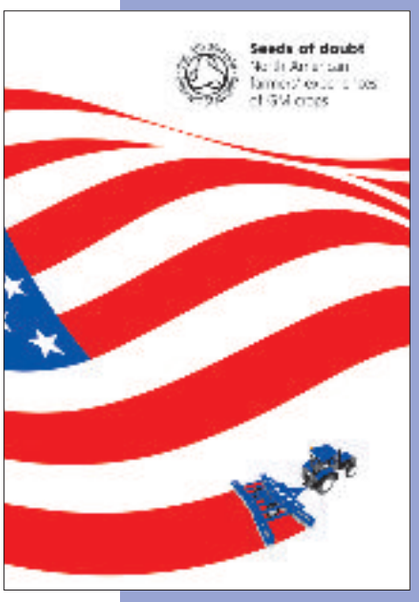

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Price £10.00
ISBN 1–905 665–24–1

Registered charity no. 206862

SA0264.1107