GREENPEACE

GM and dairy cowfeed: Steps to a GM-free future for the UK dairy industry

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Contents


THE WHITE STUFF
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Executive summary

Over the last decade, falling milk prices have brought about significant structural changes in the UK dairy industry. Herds and farms have increased in size to reduce fixed costs, with many smaller-scale farmers being forced out of business. At the same time there has been pressure to increase milk yields while reducing feed costs. This has been achieved by means of a low-cost, high-protein diet based on imported feed ingredients, increasingly supplied by a few large companies.

This process of intensification has led the UK dairy industry further and further away from its historical reliance on sustainable use of local resources, and has had a range of negative environmental impacts. Not least of these has been the industry's role in encouraging the growing of and trade in genetically modified (GM) crops.

Indeed, in contrast to the widespread availability of GM-free meat, there is at present a high likelihood that most UK-produced milk and dairy products – other than those certified as organic or produced by farms endeavouring to avoid GM supplies – come from animals fed at least in part on GM feedstuffs. This situation has arisen because two of the major ingredients of the high-protein, low-cost feeds on which the industry now depends – soya and maize derivatives – are sourced largely from countries such as the USA and Argentina where GM production is widespread and crops inadequately segregated.

Although a clear majority of the UK public remains opposed to GM food, supermarkets have so far done little to address the issue of the milk of cows fed on GM feed, and dairy products made with that milk. Meanwhile, despite recent setbacks, the Government remains in favour of GM crops being grown on a commercial basis in this country, regardless of mounting evidence that their cultivation leads to increased pesticide use with destructive effects on wildlife, and in spite of uncertainties about GM food's potential effects on human health. The commercial planting of GM crops – particularly if GM varieties of crops such as maize, oilseed rape and beet are eventually given the go-ahead – will make it even harder for dairy farmers to ensure that their cattle are fed a GM-free diet.

In this report, produced in collaboration with FARM, we demonstrate that the UK dairy industry's dependence on these GM feedstuffs could be overcome in the short term by a simple switch to available alternative feeds made from imported but reliably non-GM ingredients – at a cost of less than 1p on a litre of milk. We further show how, in the longer term, the industry could become entirely independent of imported feeds by switching to a feed regime based on a mixture of UK-grown protein crops such as lupins, clover-enriched grazing and cereal/legume wholecrop silages produced on-farm. This approach would entail some extensification of the industry, and would thus offer additional benefits in terms of animal welfare and rural job creation.

In view of the very small profit margins to which dairy farmers have long had to work, and of the human cost of the recent changes in the industry, Greenpeace sees it as inappropriate that the farmers themselves should have to bear the costs of these solutions to the problem of GM. Given their much larger profit margins, the supermarkets and other major food retailers are clearly best placed to cover those costs. Accordingly, Greenpeace looks to the supermarkets to take the lead in specifying milk from cows fed on GM-free feed, and purchasing this milk at a price which gives farmers and processors a decent margin, while pledging to work with the dairy industry towards the ultimate goal of more sustainable farming.

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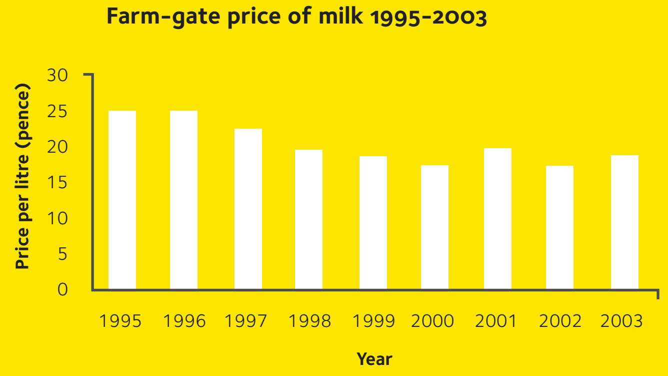
Part 1: The problems

1. Overview

The UK dairy industry has seen significant structural change in the last decade, brought about by a decline in the price producers receive for milk (see Figure 1).

Figure 1. Average producer milk prices (in pence per litre) 1995–2003[1]



This structural change has primarily taken the form of consolidation, with herd and farm sizes being increased (see Table 1) so as to intensify production and reduce fixed costs. Feed costs have also been reduced wherever possible, at the same time as steps have been taken to increase milk yields per cow.

Table 1. Average dairy farm size, herd size and stocking rate change 1998–2001[2]

	Average farm size (ha)	Average herd size	Cows per hectare
1998	82	74	0.90
2001	86	85	0.99

Milk yields have been increased through a reliance on cows bred for maximum production, fed on high-quality diets rich in both energy and protein. Given the need to provide this high-protein diet at minimum cost, the protein content of individual ingredients is an important consideration in ration formulation. Feed suppliers use least-cost ration formulation, comparing the price by weight of the protein within the constituent ingredients of the ration, and changing the composition of the ration as the costs of different ingredients vary over time. Most dairy rations will be formulated to provide between 18% and 21% protein.

In response to the need to purchase ingredients at the lowest possible price, the production of such feeds has become increasingly reliant on imported sources of protein. At the same time, the dairy supply chain has become more concentrated, with fewer, larger companies supplying the requirements of the fewer, larger milking herds. Such concentration is particularly evident in the suppliers of imported feed ingredients. Whilst this may produce economies of scale, it reduces options for product differentiation and price competition.

This process of intensification of the dairy industry has led it away from sustainable utilisation of local resources and is resulting in numerous negative social and environmental impacts. Dairy farmers with smaller farms are being forced out of business or are surviving on extremely poor incomes. The number of dairy farmers has declined from 40,500 in 1995 to 29,700 in 2002. Most of these losses have involved farmers with smaller herds (under 50 cows).[3]

From an environmental perspective the negative impacts include animal welfare and health issues resulting from high milk production requirements and a diet containing a high proportion of concentrate feeds, air pollution caused by long-distance transportation of imported feedstuffs, loss of ecologically significant habitat in some countries producing feed ingredients, increased use of fertilisers, herbicides and pesticides in relation to feed production, and perpetuation of the growing of and trade in GM crops.

2. GM dairy feed

As a result of consumer pressure, many animal products available in our supermarkets now come from animals fed on a non-GM diet. Dairy produce is one of the few areas in which little progress has been made to eliminate potential GM feed. Indeed, the only major food retailer which is able to state with certainty that its own-brand milk is produced from cows not fed on a GM diet is Marks and Spencer.[4]

This is an unacceptable situation for two reasons. Firstly, the dairy industry and supermarkets are perpetuating an international trade in GM commodities whose production poses serious environmental problems; and secondly, the majority of UK consumers do not want to eat products derived from animals fed on GM crops. Public rejection was highlighted by a poll as recently as August 2003, which found that 77% of people would prefer to eat or buy dairy, meat and fish products from animals fed on a non-GM diet.[5]

GM crops are a form of living pollution: they replicate, interbreed with relatives (both other, non-GM crops and wild plants), mutate and adapt to new environmental conditions. Whether they are destined for human or animal consumption their environmental impact is the same. Once released, genetic pollution threatens contamination of our environment and food supply, cannot be recalled and may prove impossible to contain. For example, farmers in Canada are now faced with 'superweeds': wild rape has hybridised with commercially grown GM canola (a kind of oilseed rape) giving rise to highly invasive wild GM strains which are resistant to three major herbicides.[6]

Contrary to claims from the biotechnology industry, the environmental and agronomic benefits of GM crops are highly questionable. The UK Government's farm scale trials examined how biodiversity was affected by the herbicide regime used on GM crops, compared with that used on conventional crops. The results from these four-year tests revealed that the management of GM spring oilseed rape and beet had a more detrimental impact on wildlife than the management of their conventional counterparts. Weed control in the third GM crop tested, fodder maize, appeared to have less of an impact on biodiversity in the immediate locale than was the case for the conventional crop.[7] However, the maize trials were performed using the herbicide Atrazine on the conventional crops – a chemical so toxic that it has since been banned throughout Europe.[8] In light of what it was being compared against, it is hardly surprising that the management of the GM maize had less of an immediate impact on wildlife in the crop.

Moreover, recent research from the USA has shown that the planting of GM crops has resulted in an increased use of agrochemicals over the eight-year period from 1996, giving the lie to the biotechnology companies' claims that the crops would lead to lower chemical inputs. Whilst there were temporary reductions in agrochemical use on GM crops in their first three years of cultivation, this trend reversed after the third year, when substantially greater volumes of herbicides were used than on equivalent non-GM crops, with significant year-on-year increases, particularly for GM soya and maize. In total, 33 million kilograms more agrochemicals were sprayed in the USA during 2001–2003 as a result of the growing of GM crops. In the case of GM herbicide-resistant maize, 29% more herbicides are now being used than for non-GM varieties.[9]

Increases in agrochemical use have also been reported in Argentina since GM soya was first cultivated in the early 1990s. Anticipated environmental benefits from growing the crop (such as a reduction in the soil erosion caused by previous tilling practices) have been eclipsed by the negative impacts of intensive chemical input, such as toxic pollution of neighbouring crops, fatal poisoning of livestock, and soil bacteria loss resulting in an increase in snails, slugs and fungi in crops.[10]

In truth, far from liberating us from our destructive dependency on agrochemicals, with their attendant side effects, genetic engineering represents an escalation of industrial farming practices. No less than 70% of GM crops are engineered to make them dependent on the agrochemical companies' own-brand herbicides.[11] Indeed GM research is dominated by the same handful of major agrochemical corporations that also sell the seeds, chemicals and fertilisers. This linkage between research and the agricultural supply chain reinforces the companies' control over the future of agriculture, while enabling them to tie farmers into tight contracts. Thus GM threatens to usher in a whole new era of environmental and economic problems around food production.

Consumer opposition to GM products is given further impetus by uncertainty as to their effects on human health. GM food has simply not been consumed for long enough for science to have established what dangers, if any, its consumption may pose. Nevertheless there have been suggestions that genes inserted into crop plants to alter their metabolism, for example so as to make them resistant to herbicides or unpalatable to pests, might also alter their nutritional properties in potentially harmful ways. More disturbing still, it has recently been reported in a highly respected scientific journal that DNA added to GM plants from other species can be transferred to bacteria in the digestive systems of animals (including humans) who eat them – something which the UK Government's GM Science Review Panel had considered highly unlikely.[12]

2.1. GM ingredients used currently in UK dairy feed

At present there are two principal ingredients in UK dairy rations – soya and maize gluten (see Table 2) – which are likely to be either GM or GM-contaminated, unless cargoes are explicitly certified as being GM-free. This is because these crops are largely sourced from countries where GM crops are grown commercially and not segregated from their non-GM counterparts within the supply chain.

Table 2: Price, protein and energyvalues of soya and maize gluten[13]

Ingredient	Digestible crude protein (DCP) (%)	Calculated metabolisable energy (MJ/kg DM)*	Pence per gram DCP
Soya	45	13.5	0.04
Maize gluten	17	13.0	0.06

*Megajoules per kilogram of dry matter

The USA, for example, is a key source of the maize gluten used in the UK. However, in 2003 the USA grew 63% of the global total of all GM crops, equating to 42.8 million hectares of GM soya, maize, cotton and canola;[14] and since there is no segregation of GM and non-GM products within the supply chain, all regular US exports of maize must be regarded as containing GM material. Meanwhile, soya is one of the major GM crops in the world economy and much of what is imported into the UK is sourced from GM-producing countries.

2.1.1. Soya

Soya is imported into the UK both as whole beans and meal mainly from the USA, Argentina and Brazil. Supplies from the USA and Argentina, where GM soya is grown and not segregated, must be regarded as containing GM material unless expressly certified as GM-free. Soya from Brazil has hitherto been GM-free, but now this situation may be set to change (see Section 6.1).

Soya is used in a very wide range of products, including many processed foods; large quantities of soya beans are pressed for oil, or ground and used as the basis for dairy replacement products. The soymeal used for animal feed is the residue from the oil extraction process.

Soya is a very sought-after ingredient for dairy feed since it is currently one of the cheapest sources of protein, is highly digestible and can be used in sufficient volume in feed mixes to provide the protein levels required for intensive milk production. Whilst rapeseed meal is also a cheap source of protein, only a restricted volume can be included in feed compounds because rape has negative nutritional effects on cows and is unpalatable at high concentrations.

Use of soya in animal feed has grown significantly in the UK since the ban on most animal protein sources in 1998, though accurate figures are hard to come by. The Department for Environment, Food and Rural Affairs (Defra) states that the production of retail cattle feed (including for calves and non-dairy cattle) in Great Britain was 3,834,100 tonnes for the 12 months to December 2003.[15] The Department of Agriculture and Rural Development in Northern Ireland (DARD) states that the Northern Ireland production of retail cattle and calf feed was 63,300 tonnes in 2003.[16] On the basis of these figures, total UK cattle and calf feed would have been 3,897,400 tonnes. Whilst neither Defra nor DARD holds a breakdown of what ingredients this feed contained, feed industry sources estimate that these rations would have contained around 10% soya on average.[17] Assuming that all UK-produced feed was consumed domestically, and that none was imported (other than in the form of raw ingredients), this would therefore give an estimated soya usage for all cattle feed in the UK in 2003 of 389,740 tonnes.

This estimate excludes the 160,100 tonnes of 'straights' (unmixed feedstuffs) produced during the period in Great Britain and potentially an unspecified quantity of straights produced in Northern Ireland, some of which would have been soya and a proportion of which would have been fed to dairy cows. Nevertheless, it gives an idea of the quantity of soya that would have to be replaced annually if the dairy industry in the UK were to achieve GM-free status. In fact, the actual figure would probably be somewhat lower, since the total production figure includes:

- feed (totalling 163,300 tonnes) for calves, only a proportion of which would have been dairy calves;
- feed for non-dairy cattle (accounting for a large proportion, though not all, of the 948,000 tonnes not specified as being for dairy cattle or calves); and
- an unspecified tonnage of feed made using non-GM soya imported from Brazil.

2.1.2. Maize gluten

Maize derivatives used in cattle feed in the UK are largely imported from the USA and must be regarded as containing GM material. The most significant in terms of usage is maize gluten, which is a by-product of the alcohol and starch processing industries. Its moderate protein content compared to soya and rapeseed meal means that it is generally regarded as part of the cereal component of the feed, though it still makes a significant contribution to overall protein levels. Its inclusion rate in dairy rations will vary according to prices of both it and other cereals. Prairie meal, another by-product of industrial maize processing, is a much higher-protein product, but is not used significantly in the UK because of its high price.

Feed industry sources estimate that maize gluten would have accounted for approximately 15% of total retail cattle feed production in 2003.[18] On the basis of Defra and DARD's

2003 cattle feed production statistics cited above (Section 2.1.1), the estimated maize gluten component of retail cattle feed production in the UK would have been 584,610 tonnes in this period.

This estimate again excludes the 160,100 tonnes of 'straights' produced during the period in Great Britain and potentially an unspecified quantity of straights produced in Northern Ireland, some of which would have been maize products and a proportion of which would have been fed to dairy cows. However, it gives an idea of the quantity of maize gluten that would have to be replaced annually if the UK dairy industry were to achieve GM-free status. It is also in fact likely to be an overestimate, since the total production figure includes:

- feed for calves, including non-dairy calves;
- feed destined for non-dairy cattle; and
- an unspecified tonnage of feed made using maize obtained from non-GM sources.

2.2. Potential home-grown GM ingredients that may be used in dairy feed

In the UK there has been a voluntary moratorium on the growing of GM crops since 1998. However, since this time the Government has undertaken a series of studies and consultations relating to the commercialisation of GM crops, and on 9 March 2004 the Environment Secretary, Margaret Beckett, announced that the Government would permit the commercial growing of a specified variety of GM fodder maize. Since this announcement the manufacturer of the GM fodder maize in question, Bayer, has withdrawn the crop from commercial use. The Government has since predicted that the earliest GM crops could now be grown in the UK is 2006.[19]

At the moment, non-GM fodder maize is grown as a silage crop and is a valued constituent of dairy cattle feed. While it does have some agronomic drawbacks (such as a poor nutrient budget and a tendency to exacerbate winter soil erosion) and so cannot at present be considered an ideal mainstay for the domestic dairy industry, work is under way to develop ways of growing it in an organic system that overcome these problems.[20] If GM fodder maize were commercialised, it would pose some danger of contamination of non-GM crops, via accidental seed mixing and/or pollen flow. A recent study for Defra witnessed pollen flow beyond the 80 metre recommended separation distance for growing GM fodder maize, to up to 650 metres from the GM source field.[21] As a result of this contamination risk some farmers might be unable to ensure a non-GM supply of this useful feed ingredient, ironically just when its attendant difficulties seem to be being overcome.

Following negative results in its farm scale trials, it is now doubtful that the Government will proceed immediately with the commercialisation of GM spring oilseed rape and beet. However, if they were commercialised, both crops could also end up being used as ingredients in dairy cow rations. Moreover, in both cases the dangers of cross-pollination with non-GM varieties would be considerably higher than for maize, making it potentially impossible to secure reliably non-GM domestic supplies of either crop.

Given that the UK public has already expressed grave concern about the use of GM crops for animal feed, and that consumer awareness of the possible use of GM crops as dairy feed is likely to grow if these crops are commercialised in the UK, it seems probable that the marketplace for dairy products originating from GM-fed cows would be limited. However, the mere fact that the crops mentioned above were being grown would clearly make it even harder to ensure GM-free dairy production, as farmers would be forced either to abandon other widely used feed ingredients besides soya and maize gluten, or to seek imported non-GM supplies at higher cost.

Part 2: The solutions

3. Overview

In the long term, intensive and global trade-dependent agricultural practices such as those current within the dairy industry are untenable. The protection of wildlife, habitats and landscape, the upholding of animal welfare and the need to ensure the future of rural communities all necessitate the introduction of sustainable agricultural practices that safeguard the environment, the livestock and the livelihoods of farmers. In the case of the dairy industry this will entail extensification of agricultural practices, with on-farm dairy feed production strategies based on the cultivation of high-protein forage. Such a revolution in farming practices will require the support of both politicians and supermarkets.

To reach this juncture there are some short- and medium-term steps that the dairy sector could take to stall the industry's current trajectory towards the false promises of biotechnology and further industrialisation. These are:

- the immediate adoption of feed mixes that are already certified GM-free;
- the sourcing of current ration ingredients from countries where GM crops are not grown or where they are segregated such that the identity of GM-free crops can be guaranteed; and
- in the medium term, an increase in the supply of domestically produced feedstuffs, especially protein sources, through the wider adoption of grain legume production and cereal/legume wholecrop silages.

Such steps should however be seen as intermediate points in a progress towards the ultimate goal of an extensified industry in which livestock is kept in humane conditions and fed largely on feedstuffs produced on the farm, rather than on a diet high in concentrates with its associated health problems.

4. Extensification and on-farm dairy feeding strategy

As outlined above, a sustainable long-term solution to the social, economic and environmental problems of the dairy industry would be to reverse the current trend of intensive milk production, with its reliance upon imported feed ingredients, and transfer dairy feeding strategies largely to alternative feeds grown on-farm. This would be the most economic way to replace imported protein sources, and would also free dairy farmers from the need to be constantly adjusting their rations to take account of international price swings and changes in ingredient availability.[22] This approach would, however, require a more extensive approach to dairy production.

It would also require a greater emphasis than at present upon high-quality, high-protein forages. This would not simply mean making greater use of grass, through improved grassland management and extended grazing periods, as exemplified by the 'milk from grass' strategy which has been popular as a cost reduction measure. Rather it would entail using clover-rich grass swards as the basis of the production system, supplemented with protein-rich wholecrop silages of cereals mixed with legumes (such as barley or oats with peas and vetches), and with high-protein domestic grain crops such as lupins (see Section 5.1). The use of techniques such as crimping (the crushing, clamping and preservation of higher-moisture grain and pulses) to preserve farm-produced feeds would allow for supplementary feeding.

Table 3 overleaf gives some indication of nutritive benefits and availability of a range of crops and other feedstuffs.

This strategy would obviously have various impacts on the current farming system, including the following:

- Additional forage storage and feeding systems would be required to handle the alternative feeds produced.
- The breeds of cattle currently preferred might need to be replaced with breeds more efficient at utilising forage.
- Calving pattern might need to be changed to make better use of seasonal grass growth patterns.
- Some forages (e.g. kale) fed fresh in winter would increase the moisture content of the diet of housed cows and might in turn increase the quantity of slurry produced and requiring storage.

It is also clear that not every dairy farm has the land area and/or soil or climatic conditions to make on-farm feed production a practical proposition, and hence there would be a need for some protein crops to be grown off-farm to meet farmers' needs – ideally on a local or regional basis (see Section 5).

Within much of the present-day UK dairy sector, there is admittedly little knowledge or experience of the agronomy of

Table 3. Examples of alternative feedstuffs for dairy production[23]

Feedstuff	Feed value		Availability/cultivation
	Crude protein (% in DM)	Metabolisable energy (MJ/kg DM)	
Lucerne	Protein rich forage 20% protein silage	9.5-10	Home-grown crop which prefers well drained soils with a pH above 6.5
Sainfoin	Protein rich forage 20% protein silage	9.8	Home-grown crop which prefers well drained soils with a pH above 6.5
Red clover	Protein rich forage 18% protein silage	10.1	Home-grown crop
Lupins	40% protein seeds 20% protein silage	10.5-11.5	There are three species of lupin which can be grown in the UK – white, yellow and blue.
Brewers' grains	24% protein	11.5	Bought-in product, available either wet or dry. By-product of brewing industry so supply limited. Annual supply estimated in the region of 1,000,000 tonnes.
Kale	11% protein	11	Home-grown crop
Fodder beet	12% protein	12.6	Home-grown crop
Fodder rape	19% protein	10-11.5	Home-grown crop
Stubble turnip	19% protein	11	Home-grown crop
Swede	11% protein	13.1	Home-grown crop
Wholecrop silage	12% protein	11	Home-grown crop

DM = Dry matter

some of these alternative crops. For example, use of clovers within grass swards requires careful management as they are susceptible to applications of artificial fertilisers, particularly nitrogen, and may be destroyed when herbicides are used. However, while the use of artificial nitrogen for enhanced grass production is the norm on most dairy farms and to manage with little or no artificial fertiliser would be considered difficult, clovers and other legumes actually have the potential to replace nitrate fertilisers owing to their ability to fix nitrogen in the soil. Widespread adoption of clover-rich leys and pastures would in fact go a long way to ending the nitrate runoff pollution which degrades many of the UK's freshwater habitats, as well as producing deeper-rooting swards, which are less prone to drought – liable to become a factor of increasing importance in our changing climate. Such a transition might take several years, while levels of the symbiotic soil bacteria on which the nitrogen-fixing process depends recovered from decades of high chemical inputs (though the process can be accelerated by using clover seed inoculated with the bacteria). It would also require a significant change in attitude from the majority of dairy farmers. However, the approach described, including of course zero use of artificial fertilisers or herbicides, is already current in the organic sector and greater application of it would undoubtedly lead to improvements in the technology and systems.

Because overall protein levels in the ration would probably be somewhat lower than under the present intensive regime, this approach would of necessity be based around a rather lower output per cow (of the order of 6,000 litres a year[24] as against the 6,500–7,500 currently achieved), and so would see less stress placed upon cows with a resulting improvement in their welfare. At the same time the national dairy herd would need to increase in size to make up the shortfall in production, which might offer additional rural employment opportunities. Improving the self-sufficiency of the dairy sector would also offer wider benefits, including reduced transportation of feedstuffs, both globally and locally, and balance of payments benefits as a result of reduced imports.

A system which offers so many potential advantages is clearly worthy of government-funded development, in the first instance to establish accurate costings and to ascertain how it could best be introduced with minimum impact on the current pricing structure of the dairy industry. Once a model and a timescale for the changeover had been established, it would then be the Government's responsibility to advise and assist farmers in making the transition to on-farm feed production. Of course this would not entail an instantaneous all-or-nothing changeover, but rather a progressive shift of emphasis as farmers' circumstances and local conditions permitted – which would be facilitated by a move to domestic (but off-farm) feed production as outlined in Section 5 below. Nonetheless, Greenpeace believes that, with appropriate government support, and a will on the part of the supermarkets and other major food retailers to source sustainably produced milk for their customers, the bulk of the UK dairy industry could transfer to a regime of largely on-farm and local off-farm feed production within the next decade.

5. Off-farm UK dairy feed production

Pending the widespread adoption of on-farm dairy feed production strategies, there is the potential to produce alternatives to GM soya and GM maize derivatives within the UK. This approach would have the environmental advantage of reducing transportation of feedstuffs globally, and would offer balance of payments benefits as a result of the reduction in imports. It would also form a necessary stepping-stone towards the ultimate goal of a dairy industry largely based on on-farm feed production supplemented by some high-protein feedstuffs grown domestically off-farm, as described in the previous section. Once again, however, this strategy would be reliant upon Government offering advice and encouragement to arable farmers to plant the new crops.

5.1. Soya substitution

While soya is grown in the UK on a limited scale, it remains a specialist arable crop performing best in south-east England and East Anglia, where the density of dairy farms is low. Should soya cultivation expand here, it is plausible that the dairy industry could utilise some of the resulting soymeal, while if farm toasting and milling could be proved feasible and economically justified there would be the option of growing soya on-farm where conditions were suitable. However, the varieties of soya currently available could never be grown domestically on such a scale as to replace the current levels of imported soymeal; and moreover it is more likely that domestic production would supply other higher-value markets as a priority over animal feed.[25]

As a result any domestic feed production strategy needs to be based mainly on alternative substitute protein sources. Of course, any alternative crop to replace soya in compound dairy rations would need to provide a comparable level of protein.

The most convenient such crop would be white lupin, a grain legume which is increasingly widely grown in the UK and has a digestible crude protein content of 36% (compared to soya at 45%).[26] Improved white lupin varieties now available have high protein quality and few of the anti-nutritional alkaloids previously associated with the crop. This allows them to be included in compound feed at rates of up to 15%,[27] enabling a somewhat higher proportion to be used than is typically the case for soya (at around 10%), to compensate for the shortfall in protein content. An alternative approach would be to reformulate the ration by including higher levels of mid-protein sources such as peas, beans, pelleted lucerne or kale. Another would be to rely on higher-protein forage or silage (see Section 4), including lupin in silage form, to supply the shortfall – the latter would be a cheaper option for the farmer, and would be a natural step in the transition to largely on-farm feed production outlined above. Soya-UK estimates that farmers growing white lupins for silage or combining could potentially halve their unit cost of protein in comparison to bought-in concentrates.[28]

The introduction of white lupin has increased the geographic viability of lupins as an alternative protein source, since it can be grown on soils with a pH of up to 8 (as opposed to blue and yellow lupins which are limited to a maximum pH of 7). Whilst white lupins are now grown in East Anglia for silage, blue lupins are grown for combining in Scotland, Wales, Yorkshire and Cumbria.[29] In wetter areas where dry grain harvests cannot be guaranteed or drying or storage is a problem, crimping may be a low-cost option.[30]

The other great advantage of lupins is that there are currently no GM varieties being developed in Europe. It would therefore be possible to maintain the integrity of the UK lupin crop even if commercial growing of GM varieties of the other crops referred to in Section 2.2 above did occur in future.

On the basis of white lupin grain yields of 3–3.75 tonnes per hectare, and assuming 100% replacement of soya (at 45% digestible crude protein) in compound feeds by lupin (at 36% digestible crude protein), a maximum area of 162,392 hectares of white lupin would need to be planted, producing a crop of up to 487,175 tonnes annually, in order to replace the estimated 389,740 tonnes of soya currently used in all cattle feed (see Section 2.1.1).

Other alternative grain legumes such as peas and beans do not have the required protein content to replace soya, being approximately 20% protein. The role of peas and beans in this strategy would therefore be primarily to improve the quality of forage grown for silage by increasing its protein content (as explained in Section 4), while perhaps also being used in grain form to supplement lupin as a secondary protein source.

Industrial by-products other than soymeal currently used as feedstuffs, such as brewers' grains, also lack the protein content to be used as a substitute for soya. Moreover, the domestic availability of such products is limited by the size of the industry from which the product is derived – in the case of brewers' grains most if not all of the available supply will already be used. Nevertheless, while brewers' grains certainly could not replace soya entirely, this and other by-products (such as apple finings from the cider industry) would remain useful components of the overall ration mix, whether nationally or at a local level.

5.2. Maize derivative substitution

The maize gluten used in UK dairy cow rations could readily be replaced (albeit at potentially greater cost) with a mixture of cereals and other protein sources. This is because maize gluten has only a moderate protein value and its energy value is similar to that of other cereals. There are many suitable replacements, and which ones are used at any one time will depend on price fluctuations. Domestically produced cereals such as barley, wheat and oats, along with dried sugar beet, are all suitable alternative energy sources; while maize's protein contribution could be effectively supplied by the mid-level protein sources already mentioned, such as legumes in grain or silage form.[31]

6. International ingredient substitution

In the short-term transitional phase towards domestic dairy feed production, alternatives to GM soya and maize derivative ingredients could be secured from the international market place. However, this approach would not alleviate environmental problems such as those resulting from global transportation of commodities, or decrease the current emphasis on intensive dairy production. There are also food security issues bound up with reliance on a single crop produced in a single country, to say nothing of the impossibility of predicting whether any given country's agriculture will remain GM-free in the long term. International ingredient substitution must therefore be regarded as only a temporary solution to the issue of GM feed replacement, and not in any sense a solution to the other problems intrinsic to intensive dairy production.

6.1. Non-GM soya supplies

The price of non-GM soya varies depending on its 'identity-preserved' status (i.e. its traceability, dependent on validation of the production and supply chain), shipping costs and seasonal variations in availability. The spot price premium for non-GM soya over conventional (GM) soya currently ranges between £4 and £12 per tonne. As of 4 March 2004 the spot price for conventional high protein (HiPro) soya was £192–199[32] per tonne for the period March/April and £174–189 for November/April, whereas non-GMO HiPro soya had a spot price of £196–205 (March/April) and £185–191 (November/April).[33]

Until recently, Brazil was a key global supplier of non-GM soya. This situation was temporarily threatened in 2003 when the Brazilian Government announced that it would permit the sowing of GM soya for one season in order to legitimise pre-existing illegal sowing. This activity is limited to the southern state of Rio Grande do Sul, which reports that 80% of the soya grown within its borders is genetically modified. In 2003 the state's yield was estimated as being 9.6 million tonnes, 18.5% of Brazil's total soya production,[34] so the majority of the national output is still GM-free.

Regardless of the situation in Rio Grande do Sul, there therefore remain sufficient quantities of non-GM soya in Brazil to supply the UK in the short term – the country's second largest soya-producing area, Parana, has declared itself GM-free despite the temporary relaxation of national non-GM policies. However, soya production and its associated transport infrastructure in Brazil have resulted in grave environmental consequences. Amazon rainforest and virgin cerrado (a savannah flatland) have been destroyed on a large scale. Greenpeace does not condone the purchasing of soya from land cleared after the year 2000.

The USA and Argentina are currently the key exporters of GM soya to the UK. However, unlike most GM crops, soya seed does not remain viable over long periods (in fact only for around one year).[35] Consequently these countries could, if they chose, transfer to producing non-GM soya within a very short timescale and be in a position to export identity-preserved supplies to the UK.

There is already evidence that such a transition is feasible. In August 1999 a key exporter of GM animal feed, Archer Daniels Midland (ADM), announced that it was encouraging USA farmers to segregate non-GM crops to preserve their identity. Given that at the time ADM bought a third of the American maize, wheat and soya processed into food,[36] this announcement had immediate impacts. A survey by the American Corn Growers' Association (ACGA) showed that there was a reduction of 12–20% in the farmland planted with GM crops in 2000 compared to 1999[37] – figures made all the more significant by the fact that chemical and seed companies had predicted that there would be a 25% increase in GM-planted acreage for that year.[38] Moreover, in a survey of farmers carried out in the summer of 2000, 64.2% said that their decision whether to plant more or fewer acres of GM maize in the future would be influenced by whether grain elevators, processors and exporters required segregation.[39] What has historically blocked a long-term transition to segregation of GM and non-GM crops is the fact that the small number of major US-based grain export companies have commercial interests in GM technology.

In 2001 Europe produced approximately 1.1–1.2 million tonnes of soya (mainly in Italy and France).[40] There is potential for this production to increase in the future, depending on how economically attractive it is to grow soya compared to other crops, and also on the speed of implementation of the 'single farm payment' under the reform of the Common Agricultural

Policy. This will break the link between production of specific crops and payment of farm subsidies, and may make soya a more attractive crop to EU farmers, especially if a ready market for non-GM soya is available. However, rising EU soya production is likely to become a source of premium beans for the human consumption market rather than a substitute ingredient for the animal feed sector.[41]

6.2. Substitutes for GM maize

As mentioned at Section 5.2 above, there are many possible substitutes for maize in dairy rations, and this is as true in international as in domestic terms. Non-domestic crops that could be used to take the place of maize include cassava (for protein), and rice, quinoa and citrus pulp (for energy).[42]

Another alternative would be to utilise non-GM maize grown in Europe, as already undertaken by Bank's Cargill in their Tilbury Maize product, which is sourced from France.[43]

However, the relative ease of finding replacements for maize on the domestic market may make the importing of such substitutes unnecessary.

7. Available non-GM feed

The most immediate way that GM ingredients could be eliminated from dairy cow feed in the short term would be for the dairy industry to buy existing supplies of non-GM feed.

Some dairy rations guaranteed to contain no GM ingredients are already commercially available. Feed suppliers have achieved this either by obtaining supplies of soya and maize gluten from non-GM sources or through replacing them in the ration with other ingredients such as lupins, peas and beans.

Table 4 displays the difference in price between non-GM feeds and feeds which are likely to contain GM, based on prices quoted during February 2004 by one of the largest feed producers in the country (BOCM Pauls).

Table 4. Price comparison of potential GM and non-GM compound dairy feed (£/tonne)[44]

Potential GM ingredients	Non-GM ingredients	% premium for non-GM food
Challenger £158	Response 18 £166	5%
Challenger £158	Natural 18 £174	10%

All figures are for compound feeds containing 18% protein in the ration.

Tables 5 and 6 demonstrate how extra costs for the above non-GM feeds would impact on an average dairy farmer's production costs. In each table, the bottom rows show how much extra a dairy farmer would need to be paid (per litre) in order to cover the increased costs of using GM-free animal feed. This is calculated four times in total, using the above 2004 feed price data for each of two non-GM feeds and two sets of average farm data for 2003: data on milk yields and concentrate feed usage have been taken from two different sources of average farm statistics and used in turn to calculate the costs, since there are slight deviations in the data. The final results, however, are almost identical.

Table 5. Increased costs of using non-GM feed based on Farm management pocketbook average farm data[45]

	Status quo	Non-GM feed (10% premium)	Non-GM feed (5% premium)
Milk yields (litres cow/year)	6650		
Concentrate feed usage (tonnes/cow/year)	1.9		
Concentrate feed costs (£/tonne from Table 5)	158	174	166
Feed costs (Excluding fodder – £/cow/year)	300	330.6	315.4
Change in feed costs (£/year)		30.6	15.4
Milk price increase needed (pence/litre)		**0.46**	**0.23**

Table 6. Increased costs of using non-GM feed based on Kingshay average farm data[46]

	Status quo	Non-GM feed (10% premium)	Non-GM feed (5% premium)
Milk yields (litres/cow/year)	7513		
Concentrate feed usage (tonnes/cow/year)	2.2		
Concentrate feed costs (£/tonne from Table 5)	158	174	166
Feed costs (Excluding fodder – £/cow/year)	347.6	382.8	365.2
Change in feed costs (£/year)		35.2	17.6
Milk price increase needed (pence/litre)		**0.47**	**0.23**

This data demonstrates that GM animal feed could be eliminated immediately from the dairy sector at an additional operating cost of under 1p per litre of milk. Such a switch would however require an initial reorganisation by dairy processors to ensure that separate collection, transportation and processing systems for milk from GM-free-fed cows were available from farm gate to retailer, at least until GM-free feeds had been adopted industry-wide. This reorganisation would clearly need to be stimulated by demand from supermarkets and other major food retailers, and the costs involved would probably need to be met from the retailers' margins (see Section 8 below).

Potential means to achieving this transition could include inserting a new 'GM feed-free' clause for dairy produce into the National Dairy Farm Assured Scheme (NDFAS) in return for a guaranteed farmgate price increase. (This scheme defines the standards required for produce to be awarded the British Farm Standard (red tractor) logo.) Alternatively, a new clause could be added to contracts between retailers and dairy processors to ensure dairy farmers received an appropriate farmgate increase in return for non-GM feed usage.

Of course, in itself such an industry-wide switch to existing non-GM feeds could only be a short-term solution, since a huge surge in demand would outstrip the present supply, exhausting feed suppliers' stocks and obliging them to seek additional sources of non-GM ingredients. However, this would provide an impetus towards the next step of international ingredient substitution, as outlined in the previous section.

8. Making it happen

Table 7 is an estimation of the net profits made on each litre of milk by dairy farmers, processors and retailers in 2002.

Table 7. Estimated value chain of milk supply as at September 2002[47]

	Farmer	Processor	Retailer
Cost of production*	17.5		
Price paid for milk by processor	16.6		
Purchase price of milk		16.5	
Operating costs		12.0	
Price paid for milk by retailer		31.0	
Purchase price of milk			31.0
Operating costs**			3.0
Price paid for milk by public			43.0
Net profit	**-1.0**	**2.5**	**9.0**

* All figures in pence per litre
** As at January 2004 (see reference) – data contemporary with other figures unavailable

This table demonstrates a net loss for dairy farmers, which appears to concur with industry media reports and statements from dairy representatives. For example, in early 2003 the National Farmers' Union (NFU) launched a campaign to get a 2p/litre farmgate price rise on the basis that most farmers were selling milk for less than the cost of production.[48] This stance echoed similar calls from the organisation Farmers for Action, which protested at milk processors' plants in 2003 for an increase in the farmgate price.[49] Moreover there have been few signs of significant improvements in farmers' net profits since 2002. In Wales, for example, the average net dairy farm income rose by only 1% in 2003 due to a weak milk price and a 7% increase in input costs.[50]

The largest net profit appears to be made by the retailer, although gaining data on retailer operating costs is problematic since such information is considered confidential. However, recent evidence presented to the Environment, Food and Rural Affairs Select Committee by Kevin Hawkins of Safeway indicated that estimated overheads were in the region of 3p/litre.[51] Even taking into account his more conservative estimate of retailer's gross profit (8–10p/litre), major retailers are still making a net profit of at least 5–7p/litre.

Also, it is important to consider the timing of payment along the supply chain. Milk collected from the farmer on day 1 will be delivered to the retailer on day 2, with sale to the consumer on day 3 and thereafter. On average the farmer will receive payment from the processor on day 30, with payment being made by the retailer to the processor some time after this date. The customer will pay the retailer at any time from day 3, sometimes in cash, and so the retailer has a significant benefit in holding the customer's money for 27 days or more before in turn making payment for the milk.

If the additional costs of moving to a GM-free dairy sector are to be absorbed within the marketing chain, this analysis would clearly indicate that it is the retailer that is best placed to absorb those costs. Certainly, with producer margins as tight as they are, it is hard to see how dairy farmers could make the switch on their own account, even with such a modest increase in costs, unless the supermarkets were to take the lead. Greenpeace accordingly hopes that supermarkets will respond promptly to the issue of GM milk in the same way that they have taken steps to ensure the absence of GM ingredients from other foodstuffs. We look to supermarkets to specify milk from cows fed on certified non-GM feeds, and to purchase this milk at a price which enables both farmers and processors to retain at least their existing margins, and ideally increases farmgate margins. Furthermore, we hope that they will regard this as a first step in working with their suppliers towards the goal of a less intensive, more humane, self-sufficient and sustainable dairy sector.

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[23] Elm Farm Research Centre for Greenpeace, October 2003 with additional information from Soya-UK (www.soya-uk.co.uk), NIAB and pers. comm. (March 2004), John Turner, FARM.

[24] Pers. comm., David McNaughton, Soya-UK, March 2004.

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