Farm inputs under pressure from the European food industry

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Farm Inputs under Pressure from the European Food Industry

Les Levidow
Open University
Milton Keynes MK7 6AA, UK
tel. +44-1908-654782, fax +44-1908-654825
email L.Levidow@open.ac.uk,
http://technology.open.ac.uk/cts/bpg.htm

and

Jos Bijman
Wageningen University
email Jos.Bijman@wur.nl, www.sls.wau.nl

Abstract

The rise of own-brand labels has made retailers more vulnerable and responsive to consumer concerns. In response to widespread protest, the European food industry has sought to exclude GM ingredients and to minimize pesticide usage from their supplies. In particular, retailers have developed common practices or criteria for non-GM grain and lower-pesticide methods. This cooperative approach has several aims: to maintain consumer confidence in product quality, to establish Europe-wide supply chains which meet common or minimum standards, to make supplies interchangeable, and to avoid competition for 'non-GM' or 'low-pesticide' products defined in various ways. The consequent pressures on farm inputs go beyond national boundaries, for both companies and farmers. Overall these commercial pressures favour non-GM products which help reduce chemical pesticide sprays – e.g. pest-resistant seeds, seed treatments, or biopesticides – especially for use as components of ICM methods. There remain many difficulties in basing future products upon other novel seeds. Such constraints go beyond any statutory restrictions on GM products or pesticides. Of course, government policy still influences the use and innovation of farm inputs in Europe. Conversely, however, cooperative efforts from the food industry there provide *de facto* criteria which could supersede or influence government policy.

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1. Introduction

Since the 1990s, the European food industry[1] has faced greater public concern about food safety and quality. Synthetic pesticides and GM food have symbolized more general threats from industrialized agriculture. These suspicions were intensified by a series of food safety scandals, especially the 1996 BSE crisis which began in the UK.

In the late 1990s the European food industry faced mass boycotts and public protests against GM food. This response posed a difficulty for the European industry to deal with US-exported commodity grain, whose shipments included mixtures of GM and non-GM soybeans (or likewise for maize). Some supermarkets undertook to use only non-GM ingredients, even though the GM grain had obtained EU safety approval for both food uses or animal feed.

Meanwhile an increasing market for organic food indicated greater public interest in avoiding or even deterring agrochemical usage. As an easier option than organic, some companies advertised food products derived from lower-pesticide methods, though these did not readily command a higher price.

By providing such alternative products, companies sought to gain a competitive advantage through consumer choices. In effect, consumers were 'voting' against particular agricultural methods, in lieu of a clear democratic procedure for a societal decision about contentious technologies.

This essay discusses the following questions:

- How did the food industry devise strategies for accommodating public suspicion toward GM food and synthetic pesticides?
- How do these strategies bring companies into competition or cooperation? Does this result in divergent or convergent practices around Europe?
- What are the consequent pressures on farmers' choices of seeds and pesticides?
- How do food-industry pressures relate to developments in public policy?

Before analysing the commercial pressures on seeds and pesticides, the essay surveys relevant perspectives on food-industry strategies.

2. 'Quality' criteria: strategic perspectives

Food companies seek to add and capture value on the basis of their claims for food quality. With the rise of own-brand labels [private-label products], retailers increasingly 'find themselves absorbing more responsibility and risk in the maintenance of food quality' (Flynn and Marsden, 1992). Such 'risk' links the potential for food scares andtangible harm to consumer health with competitive pressures and financial loss.

Much food is an industrial product, e.g. dependent upon industrial inputs. 'But it is also a socio-cultural symbol and a link between the human being and Nature' (Tozlani, 1998). Food companies seek to accommodate consumer concerns which go beyond biophysical characteristics – encompassing food safety and quality, environmental sustainability and ethically appropriate methods of production. The latter concerns are specially evident for animal husbandry methods (Blandford and Fulponi, 1999).

Quality can encompass health, safety, special nutritional ingredients, 'naturalness' and environmental effects of crop cultivation (Morris and Young, 2000). These aspects often become linked, though 'natural' characteristics may conflict with novel ones. For

[1] A terminological note: the term 'food industry' or 'food company' denotes both retailers and processors, unless one of those is specified

characteristics other than taste, consumer judgements depend upon information from and trust in the company.

The symbols and criteria of quality are subject to competition. Quality can mean special provenance – e.g. links with local cultivation sites and production methods (Marsden *et al*., 1999). For example, more and more French food is labelled as *terroir*, denoting its origin from specific cultivators. Sometimes quality means special ingredients or processes which improve flavour or nutritional value. In some cases quality is defined to disfavour inputs, e.g. by reducing pesticide usage.

Food companies accommodate public pressures to demonstrate that they minimize environmental pollution – e.g. energy usage, packaging, and agrochemical inputs by their suppliers. They conduct audits across the agro-food-distribution chain, in order to identify means of achieving those aims. Claims for environmental improvements generally promote the entire company's image and product range, rather than promote specific products as 'green'. This is especially true for retailers with a large portfolio of own-brand products.

In that regard, biotechnology poses both opportunities and difficulties for the food industry. On the one hand, it facilitates greater synergy with chemical processing, e.g. for convenience food or novel products. On the other hand, the greater importance of 'natural' quality may deter links between food and chemicals/pharmaceuticals (ibid.).

Drawing on these perspectives, let us examine how the European food industry devised strategies for handling GM ingredients and synthetic pesticides, with consequent pressures on farm inputs.

3. Novel Seeds: favourable and unfavourable pressures

3.1 Pest & disease resistance (non-GM)

Plant breeding has always involved a trade-off between pest resistance and yield. With the advent of the 'pesticide umbrella', less emphasis was given to pest resistance. Recently the latter has drawn renewed interest from the rise of the organic food sector. ”More than conventional farmers, organic farmers greatly value variety characteristics that contribute substantially to weed reduction, a broad resistance to diseases and pests, and improved taste and shelf life” (Den Nijs and Lammerts van Bueren, 1999, p.64). GM pest-resistant seeds are excluded from organic agriculture by the decision of national organic organizations and EU regulations along similar lines. Strangely, when the main lobby group for organic farming outlined research priorities to the European Commission, it did not mention novel seeds (IFOAM, 1999).

Nevertheless organic research institutes are attempting to develop pest-resistant seeds. They state a preference for pest tolerance over resistance (FiBL, 1999). In the case of potato fungus, for example, “Resistance breeding has mainly focused on monogenetic absolute resistance”, whose durability may be limited by the great capacity of the fungus to overcome the resistance. Polygenetic tolerance is more durable over time. In the Netherlands some research institutes have been searching for alternative sources. Marker Assisted Breeding may be a useful tool to accelerate research on polygenetic tolerance (Den Nijs and Lammerts van Bueren, 1999, p.67).

Beyond the organic sector, plant breeding for (non-GM) pest-resistant seeds has been conducted by some food processors, e.g. by Findus, a subsidiary of Nestlé. Koipe, a subsidiary of Eridiana Beghin-Say, carries out R&D on pest-resistant and better-quality oil sunflower seeds. According to Unilever, ‘We aim to maintain the highest standards at our sites and in the products we sell. Our intention is to produce superior varieties that contain natural resistance to pests and diseases, which reduces the need for agrochemicals' (Unilever, n.d.).

The Dutch potato processor Aviko has been involved in a potato breeding programme of a primary supplier company to develop potatoes with better disease resistance. These potatoes would need less pesticide. This initiative was started in response to the growing public concern over the environment impact of pesticide use in potato production in the 1980s. In Spain some companies are developing seeds which have greater resistance to pests, to avoid or minimize dependence upon agrochemicals. In the Netherlands the sugar industry has its own applied research institute for sugar beet cultivation. This institute carries out research projects on reducing pesticide use and on ICM/IPM. European sugar beet processors decide which varieties suppliers can grow and so influence the development of new varieties.

3.2 GM crops: first generation

First-generation genetically modified (GM) crops have mainly agronomic traits, e.g. Bt insect-resistance or herbicide tolerance. In the late 1990s the European food industry faced increasing pressure to exclude these GM ingredients from food products, and even from animal feed in some countries. When Deutsche Bank (1999) said that GMOs are dead, this well describes food prospects for the first-generation GM crops, though the outcome is still open for animal feed uses of those crops.

Responding to public protest, European retail chains initiated 'GM' labelling of their own-brand lines. In lieu of clear EU rules, the European food industry adopted tentative measures for voluntarily labelling GM products in 1998. These measures were product-based, i.e. dependent upon the detectability of GM ingredients. Eventually the EU rules standardized the detectability criteria (EC, 1998b). An implicit aim was to gain public trust, while avoiding competition among retailers according to different criteria for GM labelling.

Nevertheless, some major companies adopted even more stringent processed-based criteria; they voluntarily labelled GM-derived additives and even oils, in which no GM ingredients would be detectable. Thus more and more companies went beyond EU requirements. In Germany and Austria, the entire industry has moved towards negative labelling, e.g. 'GM-free' food. Some companies promote organic meat as a way for customers to avoid GM animal feed (OU BPG, 2000).

These various labelling measures in turn deterred companies from using GM ingredients in their own-brand products, to avoid labelling them as GM. At least in northern Europe, most retailers have excluded GM grain from their own-brand products; some have given public undertakings to do so. They charge no premium price for non-GM food.

Increasingly the exclusion policy is process-based, i.e. independent of detectability. Such a policy requires a documentary control system. Nevertheless most non-GM products are sold at no extra price.[2]

Alternative supply networks have institutionalized the commercial blockage of GM grain, i.e. soybean and maize (ENDS, 1999). Major retailers established a consortium to obtain non-

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[2] Those voluntary measures were eventually formalized as legislative proposals. In July 2001 the European Commission has proposed to require labelling of all food and feed derived from GMOs. By requiring the traceability of GMOs throughout the chain, from farm to table, it aims to give consumers information on all food and feed consisting of, containing or produced from a GMO. Still, food from animals fed on GM feed will not have to be labelled. Whether these proposals will be implemented (in 2003) in their current form is uncertain, given that representatives of both the food industry and the feed industry have expressed serious doubts about the feasability and verifiability of the rules.

GM grain; consortium members include Sainsbury, Marks & Spencer (UK), Carrefour-Promodes (FR), Effelunga (IT), Migros (CH), Delhaize (BE), Superquinn (IR). During 1999 efforts to exclude GM grain were made by major processors too, e.g. Unilever, Nestlé, Eridiana Béghin-Say, Gerber (subsidiary of Novartis), Frito-Lay (subsidiary of Pepsico). According to Nestlé, the largest food manufacturer in Europe, it undertook to exclude GM-derived ingredients as far as practically possible, where the public demanded it; but the company did not list in which countries this policy operated.

Unilever announced that it would no longer use GM ingredients in its European production in May 2000. It left open such options for the future: 'We are continuing to research the use of biotechnology and genetic modification in the development of new products.' The company will retain the capability to include GM-derived ingredients 'if these are shown to be safe, approved by the relevant authorities and are wanted by consumers on a fully transparent basis' (Unilever, 2000).

Animal feed is the major use of soya and maize, so far more grain would be needed overall for non-GM animal feed than for non-GM food. Segregation is more difficult for these larger quantities (Wrong, 1999). Some retailers have undertaken to sell meat only from suppliers which exclude GM-based animal feed. Others say they will attempt to do likewise, but there are uncertainties about how to guarantee adequate supplies. So far, non-GM animal feed has been established mainly in the UK and France.

Pressures to exclude GM ingredients operate across Europe for many reasons. Many food companies anticipate consumer pressures in advance, they use common sources of food materials, and they have Europe-wide markets. Those trends are exemplified by the following country-cases.

France: Domestic and foreign pressure has discouraged the use of GM grain in France. German food retailers indicated that they would not buy GM maize from French farmers (*Cultivar Actualité*, 05.05.99). In France retail and processing companies have found substitutes for GM soya or maize, e.g. non-GM or other grains (*L'Usine Nouvelle*, 27.05.99). The largest producer of animal feed in France (Glon-Sanders), as well as a Europe-wide producer of poultry (Bourgoin), have declared that they exclude GM grain; Bourgoin is also a partner of the retail chains which import non-GM soya from the USA and Brazil (*Le Monde*, 02.09.99).

Netherlands: In mid-1999 the largest Dutch retailers (Albert Heijn and Laurus) asked the suppliers of their own-brand products to label the presence of any GM ingredient. As a result, most producers changed their recipes to exclude any GM ingredients.

The Dutch Dairy Organisation (NZO) has made clear that it determines whether GM feed crops for dairy cows will be grown in the Netherlands. Among other considerations, 'consumer acceptance in foreign markets are important signals for the Dutch dairy industry'. By taking this position, it has *de facto* rejected herbicide-tolerant maize as an ingredient in animal feed in the Netherlands.

Spain: Three of the largest retail chains in Spain are owned or co-owned by French retailers, which have extended their own non-GM policy into the Spanish market. Spanish-affiliated foreign companies (Marks & Spencer, Unilever and Nestlé) have also followed the non-GM policy of their parent companies. By early 2000 Spanish food retailers adopted a policy of excluding GM ingredients from food. In 1998-99 Spain had the greatest cultivation of GM maize in Europe, but its use is limited to animal feed.

UK: By 1999 all the retail chains undertook to exclude GM ingredients from their own-brand products. Animal feed has come under similar pressure. An extreme case is the UK's largest user of fresh produce, Tesco, which has undertaken to use only non-GM animal feed. A retailer reputed for high quality, Marks & Spencer, introduced a range of meat and eggs derived from livestock raised on non-GM diets. Sainsburys is seeking suppliers of meat not derived from GM grain.

3.3 Output and processing traits

Second-generation GM crops focus on enhancing output and processing traits. Where this results in products with special nutritional qualities, the products are called functional foods. At present such products are derived mainly from changes in processing techniques or from additional ingredients, rather than from novel seeds. For example stanols, which lower blood cholesterol, are extracted from plants through an innovation in food processing (Anon, 1999). Some dairy products are enriched with vitamins and calcium. Some functional foods involve no change at all; for example, Danone promotes some products as a healthful 'Mediterranean diet' (*Le Monde*, 29.06.95).

Although functional foods currently have a EUR 15bn market in Europe, there is uncertainty about how this sector could be expanded. Some companies have withdrawn their advertising campaigns or even the products because of poor sales. The European public is sceptical of novel foods (*FT*, 12.02.00). According to a UK survey, 4/5 of people disbelieve health claims made by food manufacturers, while most regard organic food as more healthful (Finch, 2000). And some functional foods are more expensive; Benecol has four times the price of the normal spread (ibid.).

With a view towards functional foods, seeds are being modified for nutritional qualities by many companies, e.g Seminis Vegetable Seeds, Advanta and Monsanto (Ebbertt, 1998). More generally, some bulk commodity crops are being decommoditized. As foreseen by Monsanto (1997, p.10), decommoditization in R&D will move the product range beyond bulk-commodity crops – i.e. beyond the early GM crops, towards differentiated varieties with specific qualities or end-uses. Crops have been genetically modified for changes in output or processing characteristics, corresponding to various potential uses. According to a recent survey (Dibb and Mayer, 2000), GM seeds are being designed for the following changes:

Genetic modification	Potential uses
Greater level of micronutrients	'Functional foods'; alternative sources of ingredients
Lowered fatty acids	More stable cooking oils; substitute oils; therapeutic uses
Lowered starch/sugar	Industrial starch production; low-calorie sugar
Lowered protein/amino acids	Animal feed, baking, nutriceuticals, infant formula
Removal of anti-nutritionals	Reduced-allergen food, animal feed, formula
Colour enhancement	Sweeter-tasting crops, alternative sources of sweeteners

However, there are still some hurdles to be overcome in order for second-generation GM crops to become successful. There may be a gap between the technological opportunities and the needs of the food industry, for several reasons.

First, novel seeds have elusive benefits for food processing. For example, Zeneca/Calgene developed a slow-ripening tomato which has a lower water content and so requires less energy for turning into paste. However, it requires a technical change which decreases the factory yield. For such a reason, benefits are elusive because 'efficiency' gains may not materialize when the process is scaled up (Petiard, 2000). By contrast, novel microbial processes and enzymes are more advantageous because the innovation flows into production under real-life processing conditions; and because the food company inherently controls access, e.g. through patents and/or confinement in factories.

Second, major plant breeding companies have focused their R&D on the most important field crops (soybean, corn, sugarbeet, rapeseed) in order to reach the large-scale seeds market. Most food processors, which use these crops as raw materials for intermediary products, have little interest in novel characteristics. For products sold directly to consumers, minor crops may be more important. For example, Nestlé seeks improvements in beverage crops (coffee, cacao, and chicory), but their seeds have a small market.

Third, food processing companies seek exclusive access to novel seeds, especially for output traits, in order to gain a competitive advantage. This criterion may conflict with Plant Variety Registration (PVR), the rules under which an EU member state authorizes each new seed variety for general sale (EEC, 1970; EC, 1998a). It is unclear how one company could gain exclusive access to the novel seed or to its benefits under the PVR rules. Consequently, the take-up of some novel seeds may depend upon clarifying or changing intellectual property rights vis à vis the PVR rules.

Fourth, although nutriceuticals may find new markets, they may instead arouse public suspicion. Through differentiation, 'Food processing companies seek ways to improve consumer quality for all its products or for new products. But functional foods are problematic because they fall into a grey area with pharmaceuticals', according to a Nestlé officer (Petiard, 2000).

Fifth, GM-derived food poses a problem for retailers, as exemplified by the slow-ripening GM tomato from Zeneca/Calgene. The derived tomato paste was marketed exclusively by Sainsbury's UK in 1997, at a lower-price than comparable non-GM products. Clearly labelled 'GM' from the start, the product drew no public criticism, even after Monsanto's GM soybean became a target of protest. Nevertheless the tomato paste was withdrawn when Sainsbury's moved to exclude GM ingredients from all its own-brand products in 1999. Apparently the GM tomato paste became a casualty of larger-scale decisions.

4. Pesticides: lower or different usage

During the 1990s pesticide-reduction guidelines were being implemented and publicized by some major food companies (Van der Grijp and Den Hond, 2000). Consequently farmers reduced the total amount of agrochemicals. Some food companies (e.g., Unilever) even list the pesticides that the supplying farmers are allowed to use on their farm.

These pressures have become more formalized. The food industry funds some research on pesticide-reduction methods, which can influence the types of agrochemical inputs as well as the quantity used. According to Unilever (1998), it has developed guidelines for the growing of vegetables and tomatoes.

For many small and medium enterprises (SMEs) in the agrochemicals sector, environmental pressures from the food industry have been as important as those from regulation. In response they have strengthened their R&D investments, especially by targeting pest- and disease-resistant varieties (Grávalos and García, 2000).

Amongst various efforts to reduce pesticide usage, there are three main approaches: organic, integrated, and precision (or rational).

4.1 Organic agriculture

By definition, organic farming uses only biopesticides or no pesticides at all. It depends upon farmers' knowledge of methods and alternative inputs which help to avoid pest problems. Generally it has a higher price, though some UK retailers have undertaken to sell organic food at a comparable price.

In response to consumer demand, organic food lines are being expanded greatly by major food retailers; they are being extended to processed foods as well as fresh produce . Major food processors have entered the organic market, e.g. by establishing their own product lines or by acquiring a specialist organic company (van der Grijp and den Hond, 2000, p.14). Organic farming still encompasses only 2% of European agricultural land, though a much higher percentage in northern Europe, and it may become a mainstream part of European agriculture (Padel et al., 1999).

Organic farming generates new knowledge of agronomic processes by farmers (Murdoch and Morgan, 2000). It also stimulates innovations in biopesticides. For example, research priorities include replacements for the copper-based salts currently used as pesticides by organic growers (IFOAM, 1999). The EU is banning their use for protecting grapes in 2002, so alternatives are being sought.

4.2 Integrated agriculture

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'Integrated agriculture' reduces the need for pesticide usage and can change the types used. It aims to keep pests under control so that they cause no economic damage, rather than try to eliminate them entirely. Like organic methods, integrated agriculture depends on farmers' knowledge (Perkins, 1982; NRC, 1987). In particular:

- Integrated Crop Management (ICM) selects components of the farm system to avoid pests. These include soil management to enhance crop health, resistant cultivars, natural predators, limits on pesticide or mineral residues, etc.
- Integrated Pest Management (IPM) is an earlier concept which has become part of ICM. IPM manages the cultivation system to control pests, e.g. through crop rotation, fertiliser application, soil preparation, time of sowing, etc.

Food products derived from ICM/IPM methods are becoming a general standard rather than a specific market. They are generally sold at the same price as conventional products. IPM lacks any special recognition in food markets in many countries.

During the 1990s many retail chains promoted such approaches through pesticide-reduction guidelines for their suppliers. Building on such practices, the Euro-Retailer Produce Working Group (EUREP) adopted a Good Agricultural Practice (GAP) Protocol in 1997 and revised it in 1999. The detailed guidelines emphasize ICM methods for avoiding pest problems (e.g. through resistant varieties, crop rotation, soil management) and for minimizing pesticide usage and its effects (e.g. through biological control, mechanical methods, regular crop monitoring, seed treatments rather than foliar sprays). It makes distinctions among crop-protection methods:

> seed treatments are preferred to foliar sprays;
> biological or mechanical methods are preferred to chemicals; and
> varieties should possess resistance/tolerance to commercially important pests and diseases (EUREP, 1999).

The GAP Protocol affects competition among companies and farmers in several ways. On the one hand, it helps to avoid competition for sales on the basis of lower pesticide usage (apart from their 'organic' lines). On the other hand, all retailers come under pressure to join the scheme, and potentially all farmers come under pressure to follow the Protocol. In effect the earlier company guidelines are extended to the Europe-wide food industry and potentially beyond, to foreign suppliers. Contractors will validate compliance in each country.

For most retailers, fresh produce is an important product category because it provides good opportunities for strengthening company identity and customer loyalty (Bech-Larsen, 2000). Particularly for fresh produce, retailers want to give consumers a safety guarantee. In order to do that, they have set up their own quality and safety control systems for the whole supply chain, including requirements for the use of inputs like seeds and pesticides. As this supplychain integration (or co-ordination) could make retailers dependent on particular suppliers, they are seeking to develop quality standards that will be implemented by numerous suppliers in Europe, such as the EUREP Protocol (Brouwer and Bijman, 2001).

4.3 Precision agriculture

Precision agriculture lowers pesticide usage by using more precise methods (Den Hond et al. 1999). For example, farmers decide more carefully what applications are really needed. They treat parts of a field separately, according to specific conditions there; and they replace high-volume products with low-dose ones, which are often more expensive. Using information technology, expert decision-systems can replace farmers' judgements. Although overlapping somewhat with ICM/IPM, precision farming can be distinguished as an initiative from food processing and agrochemical companies.

Called *agriculture raisonée* in France, this approach has been promoted by major food companies (e.g. Auchan, Carrefour and Danone), the chemical industry and major farmers'unions through a network of a hundred-odd farms. According to Danone, it must be "the new standard of agriculture"; this company works with producers' organisations to reduce pesticide applications on cereals. Agrochemical companies provide 70% of the budget for the Forum de l'Agriculture Raisonnée Respecteuse de l'Environnement (FARRE). There is no national certification system, so the proportion of *agriculture raisonnée* is not known (*Le Monde*, 01.03.99). Food from precision agriculture is sold at a 10% premium price.

4.3 Pesticide reduction: national examples

Pressures to reduce pesticide usage operate across Europe, especially because farmers and companies sell their products across national boundaries. The following examples emphasize mainstream farming rather than organic methods.

France: The largest food retailer, Carrefour, plays a leading role in the GAP Protocol; lower-pesticide products become the standard, rather than being specially labelled. Quality-oriented retailers publicize the low-pesticide methods of their suppliers, while charging a 10% extra price (*L'Usine Nouvelle,* 11.03.99). Casino advertises such products with a special label, *terre et saveur,* while Auchan created a label, *agriculture raisonée (Le Monde,* 05.03.00).

Netherlands: Pesticide-reduction efforts had its origins in government policy, especially the 1991 Multi-Year Crop Protection Plan. In response pesticidereduction was promoted by Albert Heijn, which has approx. 1/4 of all food retail sales there. In 1997 it extended its ICM programme to its foreign suppliers, particularly from Spain, France, Israel and Italy. It aims to sell fresh produce only from ICM or organic cultivation practices (Van der Grijp and Den Hond, 2000). Interestingly, environmental impact and sustainability are no longer the key driver behind Albert Heijn's pesticide-reduction efforts: consumer health has become the main focus of attention. In October 2000 the company announced that it will seek to sell only residue-free products.

Spain: The GAP Protocol guidelines are followed mainly by Spanish farmers who supply European retailers. Since 1998 some producers in Spain (e.g. Martinavarro) have participated in pilot trial projects to verify that the GAP Protocol is being implemented. There are no public data on the numbers of farms that have adopted ICM practices, though these practices are more widespread in horticulture than in arable crops.

UK: Major retailers emphasize that they follow the GAP Protocol, which generalizes practices previously developed by Sainsbury's. That company in particular is attempting to develop verification procedures for overseas suppliers, to complement the verification already being devised for European suppliers. ICM methods have been developed on Demonstration Farms by a programme called LEAF, 'Linking Environment And Farming'.

5. Public policy interactions

Changes in European public policy have given both farmers and food companies incentives to develop cultivation methods using fewer and more benign pesticides. These incentives come from reform of agricultural policies and from more stringent regulation of product safety.

The EU's Common Agricultural Policy has been broadened from targeting farmers towards promoting integrated rural development. *Agenda 2000* decisions have institutionalised the new goals of the CAP (European Union, 2000). The 1999 Berlin European Council affirmed that the CAP reform would aim to secure a multi-functional, sustainable and competitive agriculture throughout Europe. Under this policy, agriculture has to maintain landscape and countryside, contribute to the vitality of rural communities and respond to consumer concerns – regarding food safety quality and safety, environmental protection and animal welfare standards.

As a general effect of CAP reform, farmers become more vulnerable to market incentives, including special demands from their purchasers. As another more specific element, the payment of income support becomes conditional on compliance with specific environmental requirements. As this so-called 'cross compliance' is implemented by the national authorities based on particular national demands, there may be greater differentiation of environmental requirements across countries. Given that food processors and retailers purchase ingredients and produce goods on an international scale, they do not favour such a differentiation. Therefore, they are trying to establish their own requirements on a broad European scale.

In response to consumer concerns about food safety issues, moreover, legislation is becoming more stringent. This in turn has pressurized the food industry to design and implement quality and safety control systems throughout the supply chain. For example, since the UK introduced the 1990 Food Safety Act, with its 'due diligence defence', retailers and food processors are required to do all that is reasonably possible to ensure that their products are safe (Henson and Northern, 1998). These quality and safety monitoring systems also cover the purchase and use of farm inputs.

6. Conclusions: pressures on farm inputs

For their overall competitive advantage, European retail chains have generally built up own-brand product lines, designed to symbolize product quality. This role in turn has made retailers more vulnerable and responsive to consumer concerns. While they compete over distinctive aesthetic characteristics of products, retailers have decided to cooperate over standardizing some process characteristics which are less readily detectable to consumers, who therefore depend on company information.

Facing public suspicion towards GM food and synthetic pesticides, the European food industry has put pressure on the corresponding farm inputs. Retailers have developed common practices or criteria for non-GM grain and lower-pesticide products, e.g. IPM/ICM methods. Such criteria apply to all product lines, not just to specialty products. This cooperative approach has several aims: to maintain consumer confidence in product quality, to establish Europe-wide supply chains which meet common or minimum standards, to make supplies interchangeable, and to avoid competition for non-GM or low-pesticide products defined in various ways.

The resulting commercial pressures go beyond national boundaries. Given the strong consumer signals in some countries, food companies have been changing their supply-chain practices throughout Europe. Likewise, farmers have come under pressures from food companies based in other countries or marketing products there. In such ways, pressures on farm inputs become Europe-wide, for both companies and farmers.

Food processing companies too have accommodated such consumer pressures. For pesticide reduction, some companies have helped to fund research on pest-resistant seeds and alternative chemical agents; some have also promoted precision (rational) agriculture methods, as distinct from IPM/ICM methods. At the same time, processors have relatively greater interest in differentiating their products from competitors' in other respects. Unlike retailers, they research novel seeds which may provide consumer benefits and gain public acceptability, while seeking exclusive control over such products.

As regards novel seeds, food retailers and processors have exerted pressure against the first-generation GM crops for use in food, and even for use as animal feed in some countries. Food processors and seed companies still investigate ways to base future products upon other novel seeds, e.g. GM seeds for functional foods, though such links may be difficult to establish for several reasons:

- Food-processing advantages have been obtained and controlled more readily from microbial methods than from novel seeds. Likewise nutritional advantages have been obtained mainly from changes in processing methods.
- Novel crops with special nutritional characteristics may pose problems of European public confidence – e.g. because they blur the boundary between food and pharmaceuticals, because they are perceived as unnatural, or simply because they involve GM crops.
- The largest, most lucrative seed markets may not correspond to the crops for which food companies want novel seeds, e.g. coffee.
- A food company can gain a market advantage from a novel seed only if it has exclusive access, yet such an arrangement limits the prospective market for a plant breeding company. Such companies and farmers may not accept dependence upon just one purchaser.
- Pesticide-reduction may be achievable by changing the cultivation methods or the pesticidal agent, rather than the seed.

As regards synthetic pesticides, food retailers and processers have exerted pressure upon farmers to reduce pesticide usage; verification procedures are being devised. Unlike the organic sector, these pressures potentially affect most of European agriculture. They may also offer incentives for changing the type of pesticide used.

In sum, the European food industry has sought to exclude GM ingredients and to minimize pesticide usage from their supplies, thus implicitly protecting the ‘quality’ reputation of their own-brand lines. Overall these pressures favour non-GM products which help reduce chemical pesticide sprays – e.g. pest-resistant seeds, seed treatments, or biopesticides – especially for use as components of ICM methods. There remain many difficulties in basing future products upon other novel seeds.

Such commercial constraints on farm inputs go beyond any statutory restrictions. Whereas pressures on farmers to reduce the use of particular inputs used to come from government regulation, nowadays food-industry pressures are increasingly important. Cooperative efforts from the food industry provide *de facto* criteria which could supersede or at least influence public policy.

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