

PITA

**Policy Influences on Technology for Agriculture:
Chemicals, Biotechnology and Seeds**

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**South Jutland University Centre (SUC):
Villy Søgaard
Jesper Toft**

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List of Abbreviations

AU	=	University of Aarhus
AUC	=	University of Aalborg
BI	=	Institute of Biotechnology
BIOTEK	=	Public funded research programme on biotechnology
CAP	=	Common Agricultural Policy
CEECs	=	Central and Eastern European Countries
DCC	=	Danish Consumer Council
DDD	=	Danish Directorate for Development
DFU	=	Danish Institute for Fisheries Research
DIFTA	=	Danish Institute for Fishery Technology and Aqua Culture
DJF	=	Danish Institute of Agricultural Sciences
DMU	=	National Environmental Research Institute
DTU	=	Denmark's Technical University
DVFA	=	Danish Veterinary and Food Agency
DWC	=	The Drinking Water Committee
EC	=	European Commission
EPA	=	The Environmental Protection Agency in Denmark
EU	=	European Union
FDB	=	The largest Danish Consumer Co-operative
FDI	=	Federation of Danish Industries
FØJO	=	Research Centre for Organic Farming
FRF	=	The MFAF's Advisory Research Committee
GMO	=	Genetically modified organism
IL	=	Institute for Chemistry and Nutrition
KU	=	University of Copenhagen
LØJ	=	National Union of Organic Farmers
MAPP	=	Research programme on Market-based Process and Product Innovation in the Food sector
MFAF	=	Ministry of Food, Agriculture and Fisheries
MoE	=	Ministry of the Environment and Energy
NGO	=	Non-Governmental Organisation
NOAH	=	Danish Section of Friends of the Earth
NPO	=	Nitrate, Phosphorous, and Organic water
NVZ	=	Nitrate Vulnerable Zone
OU	=	Odense University (now part of the Southern Danish University)
PGS	=	Plant Genetic Systems
RKP	=	Recipient Quality Planning
RUC	=	Roskilde University Centre
SF	=	The Socialist People's Party
SJFI	=	Danish Institute for Agricultural and Fisheries Economics
SSL	=	Danish Pest Infestation Laboratory
STI	=	Science, Technology and Innovation

SVIV = Danish Veterinary Institute for Virus Research
SVS = Danish Veterinary Laboratory
WTO = World Trade Organisation

Executive Summary

1. The national science, technology and innovation policies (covering the Intellectual Property Rights regime, technology support and extension, and market regulations) seeks to pursue a dual strategy of maintaining and improving national competitiveness by developing the knowledge base concerning genetically-modified and functional foods while simultaneously supporting the development of organic farming methods.
2. The most important environmental issues studied in section 3 are to do with water policy. The leaching of nutrients as well as pesticides has caused several rounds of public debate and political action to prevent eutrophication and protect supplies of drinking water.
3. Another important issue is the release of genetically modified organisms (GMOs). New GMOs have to be approved on the basis of both environmental and health aspects by the national authorities.
4. The labelling of GMOs has been a major issue in Danish environmental policy. Strict national labelling requirements (beyond the principle of substantial equivalence) appear to have hampered the introduction of GMOs on the domestic market. National labelling practices have now been harmonised.
5. In general, a recurrent issue in Denmark has been the possibility of applying the ‘Environmental Guarantee’ at EU level to uphold stricter national regulations.
6. National farm support is quantitatively insignificant. It pertains to structural development, organic farming, agricultural extension, and product development.
7. Denmark has traditionally been a net beneficiary of the CAP, and a reform involving a reduction of export subsidies and a decoupling of income support runs counter to Danish agricultural interests. However, the national policy network (consisting of the Ministry of Food, Agriculture and Fisheries and the major agricultural organisations) now officially supports a general liberalisation of world trade accompanied by higher environmental standards at EU level. It stresses the need for a gradual reform, however, to protect farm incomes, and maintains that tendencies to renationalise farm support should be opposed at EU level.
8. There thus are many tensions between the policies studied. Within the science, technology and innovation framework there is a conflict between labelling practices accommodating popular opposition to GMOs and a policy objective of stimulating biotechnological research to maintain international competitiveness. There are obvious tensions between environmental protection policies (such as levies based on the polluter pays principle) and policies to support agricultural competitiveness and incomes. At EU level Denmark’s role as a ‘forerunner’ on environmental issues has been compromised in some respects by agricultural export interests.

1. Introduction

The aim of the PITA project is to analyse the impact of *Policy Influences on Technology for Agriculture*. In particular, focus is on the possibilities of supporting the development and adoption of more environmentally sustainable methods of production within this sector.

The environmental impact of farming obviously depends on the technologies used by farmers. Those technologies are largely developed outside the primary sector, however. Thus Keith Pavitt, in a now classical study on sectorial patterns of technical change (Pavitt, 1984), categorised agriculture as a supplier dominated industry, relying heavily on its inputs sectors for technological innovation. Like other supplier dominated industries¹, the farming sector is composed of fairly small enterprises characterised by weak in-house R & D and engineering capabilities. Moreover, being price takers in almost perfectly competitive markets, firms within this sector are in no strong position to appropriate the financial returns from such investments.

As Pavitt observes, “most innovations come from suppliers of equipment and materials”, and there are strong systemic pressures forcing farmers to adopt new technologies to survive. Since Cochrane’s seminal work in the late 1950s (Cochrane, 1958) these systemic pressures have been known as the agricultural treadmill.

It is appropriate, therefore, to focus attention on those sectors in which the main inputs are developed and analyse how the technological trajectories may be influenced by the policy framework at national and international level. In the PITA project the agrochemical industry, the biotechnology industry and the seeds industry have been selected as core industries for analysis. Not only does the output from these sectors have a substantial impact on the environmental consequences of farming. These sectors are also among the most highly innovative input sectors.

The purpose of the present report (Objective 1 of the PITA project) is to set out an inventory of national level policies that may be assumed to influence innovation decisions within the agrochemical industry, the biotechnology industry or the seeds industry. This includes science, technology and innovation policies (Chapter 2), international trade policies (Chapter 3), environmental protection, public health and biodiversity (Chapter 4) and farm support (Chapter 5). The relevant interactions among this broad range of policies are discussed in Chapter 6, and Chapter 7 concludes with some research questions, expectations, and hypotheses concerning the impact of the policies presented on the innovation processes in agrochemical, biotechnology and seeds industries. A short description of the structure of Danish farming is given in Appendix A at the end of this report.

¹ Drawing on Scherer’s analysis of inter-industry technology flows in the United States (Scherer, 1982), Pavitt mentions housebuilding, textiles, lumber, wood and paper mill products, printing and publishing as examples of supplier dominated industries.

2. Science, Technology and Innovation

2.1 Introduction

This Section describes the national science, technology and innovation (STI) policy framework for the biotechnology, agrochemical and seeds industries. Focus here will be on biotechnology, since this is a designated research area for national support. As for the seeds industry, there is no public STI policy (although public sector research institutes (PSREs) co-operate with the seeds industry). Public regulation of the seeds industry is practically synonymous with the national implementation of EU regulations.

The dominant issues addressed in this Section are:

- technology policy (technological development programmes)
- attempts to strengthen the market orientation of food production.
- labelling issues
- organic farming as a strategic growth area
- appropriability (patent rights)

The central dilemma faced by the national science, technology and innovation policies vis-à-vis the biotechnology industry is to be found in the tension between the next two aspects. On the one hand the highly sceptical attitudes within the general public. And on the other hand public policies to promote the development and adoption of these technologies to retain and improve the international competitiveness of Danish food production (PLS Consult, 1997). This dilemma has led to a dual strategy of

- *supporting the development of bio and gene technology*² as part of a wider policy to uphold international competitiveness and remain technologically advanced while
- *developing the organic sector* (in which gene technology is not permitted by Danish regulations) as a strategic growth area.

This dual strategy should be seen in the light of international market conditions. Thus, the Food Ministry's Advisory Research Committee, in its recent strategy paper (Danish Directorate for Development, *Strukturdirektoratet*, 1998), expects a stronger market orientation of the agricultural policy of Denmark and the EU with a reduction of price support in the coming years. It will be crucial to agricultural competitiveness to remain technologically advanced and develop products of a high quality and value for the global high price markets on a continual basis (Danish Directorate for Development, 1998:11). Biotechnology has therefore been designated a research area of special interest.

2.2 The need for more innovation and a stronger market orientation

² The Ministry of Business and Industry has set up a working group on the social understanding of biotechnology. The aim of the working group is to create a basis for the commercial use of gene technology. The working group will discuss its conclusions with interest groups from industry and NGOs.

A recurrent issue in public debates concerning the Danish food sector over the past 10-20 years has been the (alleged) need for a stronger market orientation and intensified product innovation. The policy perspectives underlying this discussion have changed over the years, however. In the 1980s the food sector was seen as a potential industrial ‘locomotive’ needing a strategic injection of money to help it pull the Danish economy further away from the “precipice”³. An acceleration of (product) innovation, especially for high-value products, was a central element in this strategy. Thus, in a paper from the Ministry of Agriculture it was stated that

“In summary, Danish food research can be said to be modest, dispersed, uncoordinated, and process oriented. For these reasons it is feared that the Danish farming sector and food industry has been left with the role of staples supplier, cut off from those customers who are prepared to pay a higher price for highly-processed food products.”

(The Ministry of Agriculture, 1987: 7)

Similar arguments were forcefully advanced by the so-called *Forum of Industrial Development* (a policy think tank established by large institutional investors), anticipating a “comprehensive transformation of eating and drinking habits, demanding healthier, better, and more convenient food products...” (Forum of Industrial Development, 1989: 1). The Forum ceased to exist in 1992.

In the mid-1980s a number of public research and development programmes were launched on an interministerial basis to improve the innovativeness of the food industry. The original intentions were to “cover the range from building up the foundations in basic science, supplemented with strategic research, to the launching of initiatives to encourage the commercial implementation. The time schedule was a ten-year period from 1985 until 1996.” (PLS Consult 1997). This approach reflected what has come to be known as a ‘linear model’ of innovation, based on the perception of innovation as a mainly science-based activity.

This applied, for example, to the BIOTEK programmes, which were rather ambitious programmes to establish research centres ‘without walls’. The first BIOTEK programme ran from 1987 to 1990, allocating a total of ECU 51 m to biotechnological research across a wide range of areas (including health care and the development of pharmaceuticals and vaccines). BIOTEK 2 funded a number of research centres including the Centre for Plant Biotechnology. The programme has been positively evaluated, although in the final evaluation from the Research Council industry reactions were somewhat reserved as concerned the commercial value of the programme (*The Committee on Biotechnology*, 1997).

The original intentions of interministerial collaboration were not carried out, however. Instead the various Ministries set out on their own. Thus, the Ministry of Education initiated the BIOTEK programmes to further university research and education within biotechnology. A wider food technology programme, FØTEK, was started in the autumn of 1990. The aim of this programme was to combine basic research with a number of collaboration projects between researchers and food companies. FØTEK is basically a technological research programme and includes some biotechnological projects. There is also a sub-programme on

³ In the early 1980s the Social Democratic Minister of Finance had warned that the Danish economy, with its chronic deficits in the balance of payments, soaring interest rates and mounting public debt, was standing “at the edge of the precipice”.

marketing, known as the MAPP research programme, MAPP being an abbreviation for Market-based process and product innovation in the food sector (Grunert *et al.* 1996).

In terms of its commercial value the FØTEK programme has been very positively evaluated. Thus, according to one evaluation, many companies attributed an increase in turnover and employment to their participation in the programme or felt that it had helped them build up competencies (PLS Consult, 1998).

In conclusion, the interaction between the public and the private sector in furthering research appears to have been relatively successful when viewed from a business perspective. The public anxieties about biotechnology apparently have not translated themselves into political barriers to this sort of initiative. Public scepticism appears to have had its major impact on policies related to the labelling and patenting of genetically modified products. We shall therefore address these issues in the following sections.

2.3 The labelling of genetically modified inputs

Denmark generally follows the same labelling practices on food as the rest of the EU. However, in relation to some food products Denmark operates its own, stricter, labelling practices, which appear to have had quite significant market effects. In some cases national labels were introduced prior to EU harmonisation, but the principle of ‘Consumer Sovereignty’, i.e. of giving the consumer an informed choice, has also played an important part. For example, Denmark has had a State controlled organic label for many years. Also, national labelling requirements apply to irradiated foods. Irradiated ingredients such as spices must be labelled in Denmark - as the only such country in the world (Toft, 1985). In this subsection we shall describe the Danish labelling policy, its market implications, and the reactions it has provoked from various interest groups.

In the early 1990s the labelling of genetically modified foods became a public issue at a more hypothetical level since no products were on the market at that time. The labelling discussion took a new direction in 1994, mainly inspired by a report on the Novel Foods Regulation (NFR) (Toft, 1994). This report recommended that all genetically modified foods be labelled - not for safety reasons, but to allow consumers the right to make an informed choice.

These discussions were followed by a motion from SF (the Socialist People’s Party) in Parliament in December of 1994. All parties requested Government to work for a Danish policy that no marketing of genetically modified foods should be allowed without clear consumer labelling. The labelling requirements explicitly went beyond the principle of substantial equivalence: “Genetically modified foods should be labelled even if their characteristics and physical appearance are not crucially different from those of a non-genetically-modified product” (*Folketinget’s* proceedings, 1994).

The Danish EPA found that a consistent policy of prior labelling of seeds designated for human consumption would be required to enforce this decision. Consequently, prior labelling has been a criterion for Danish positions on all environmental marketing releases of genetically modified products for human consumption. Unless a genetically modified product, such

as seeds, is labelled at the first stage, the genetically modified seeds would not be traceable in the food chain and labelling could be misleading to the consumer.

This caused the Minister of Health to introduce Denmark's own labelling practices in the wake of the first Danish approval of a modified product, the genetically modified soya and the second Danish approval of the genetically modified maize for human consumption. No link to genetically modified feed was made in the two cases or in the Danish Act, probably because labelling is harmonised in the EU so that no Member State is allowed to introduce mandatory labelling of genetically-modified feed.

The Minister of Food, Agriculture and Fisheries offered that if the food industry or food retailers were interested, he would set up a Government supported negative labelling scheme (guaranteeing that the product had not been produced on the basis of genetically modified inputs). Neither industry nor retailers were interested, however, and so far no such scheme has been set up.

The effects of national labelling on the Danish home market appear to have been quite substantial. Nearly all producers started demanding traditional soya or to substitute soya with other ingredients (e.g. rapeseed oil). Some products containing genetically modified ingredients have been introduced in silence, though. However, due to the activities of Danish Active Consumers and Greenpeace, who acted as 'food detectives', all products such as oregano bread, popcorn, taco-chips, tuna in oil and salad dressings were withdrawn from the market shortly after their introduction (Toft, 1997b). At the time of writing (August 1998) no product containing modified soya or maize is on the market - provided, of course, that the food industry lives up to the existing labelling requirements.

Thus, the Danish labelling criteria combined with the opposition from consumer groups have clearly affected the marketing of genetically modified foods. It seems that no food company has wanted to be the first one to introduce genetically modified foods. Therefore, the food industry has been in a waiting position until Regulation 1139/98 would come into force by which time the documentary control of genetically modified foods would be abandoned.

The national labelling regulations have provoked a variety of reactions.

- The Federation of Danish Industries opposed the separate Danish labelling system on the basis of the equivalence criterion, arguing that it would unfairly disadvantage Danish producers: "It is important to underline that the discussion is not about the quality of products but only an ideologically-based dissociation from the methods of cultivation" (The Federation of Danish Industries, 1996).
- The Danish Food Industry stated that "labelling under 90/220 can only be demanded if any risk with the use of the products exists, which is not normally so". Consequently, "the Danish demands on labelling go further than required by the common regulation" and therefore "these demands are mainly political signals. It is disputable what these signals mean for a positive attitude to gene technology in industry, in the general public and in the international community" (PLS Consult, 1997).
- The largest Danish Consumer Co-op - *FDB* - favoured labelling to allow consumers the right to make an informed choice. But faced with genetically-modified soya and its use as an ingredient in nearly 2/3 of all processed food items, *FDB* found that labelling soya

would not give the consumer any choice. On the other hand, in its own-brands food no genetically modified ingredient will be allowed.

- The Danish Consumer Council initiated a so-called dialogue forum consisting of representatives from agriculture, industry, trade unions and the Consumers Council itself with different civil servants as observers. No environmental NGOs or other consumer groups were invited although they have been the major pressure group on the subject. The dialogue forum issued a pamphlet on the genetically modified soya distributed to all supermarkets.

To conclude, the Danish experience suggests that labelling have very serious market implications. The central issue is: who decides what sort of information is 'relevant' to the consumer? Should the consumer interest be confined to the physical characteristics of the product (as implied by the principle of substantial equivalence), or is it relevant to inform (political) consumers on production methods and other aspects of the product in the shelf?

2.4 The further development of organic farming

Although the PITA project is concerned mainly with issues relating to the conventional farming sector (accounting for about 98 per cent of the total value of agricultural production in Denmark), the organic sector deserves consideration for two reasons.

Only about 2 per cent of all farm units in Denmark are organic farms. The organic sector is growing rapidly these years, however. It is estimated that the number of organic farms will increase by no less than 40% during 1998. Therefore, the long-term market implications (from the perspective of the agrochemical industry, for example) of the process of conversion should not be assessed on the basis of the organic sector's current share of the market. It is expected that organic farmers will cultivate some 4-5 per cent of total arable area by the year 2000. In the milk market, the present market share is around 10 per cent (and close to 50 per cent in central Copenhagen)⁴. Secondly, and perhaps more importantly, even if the organic sector remains small, it may provide market opportunities for competing technologies (alternative cleansing systems, for example) which can have spin-off effects within the conventional sector.

Despite its present size, the long-term perspectives of the organic farming sector are increasingly being taken seriously. Thus, according to a newspaper interview with *Børsen* (a leading Danish business paper), Asbjørn Børsting, chairman of the Advisory Research Council, distanced himself from a niche-perspective on organic farm production, arguing that it should become one of the strategic growth areas of Danish Food Production. This is no longer a surprisingly radical point of view. For example, according to an analysis presented in *Ugebrevet Mandag Morgen* (the weekly Newsletter *Monday Morning*)⁵ in 1997: "Denmark could

⁴ The introduction of a public labelling system - the red, State Controlled, Ø label - is often seen as one important factor behind the relative success of organic farming in Denmark. Also, the *Action Plan for the Promotion of Organic Food Production* from 1995 contributes to the further expansion within this sector (cf. Section 4 below).

⁵ *Mandag Morgen* may be seen as a Danish (and perhaps more policy oriented) counterpart to *Business Week*, i.e. a serious magazine for decision makers in politics and business.

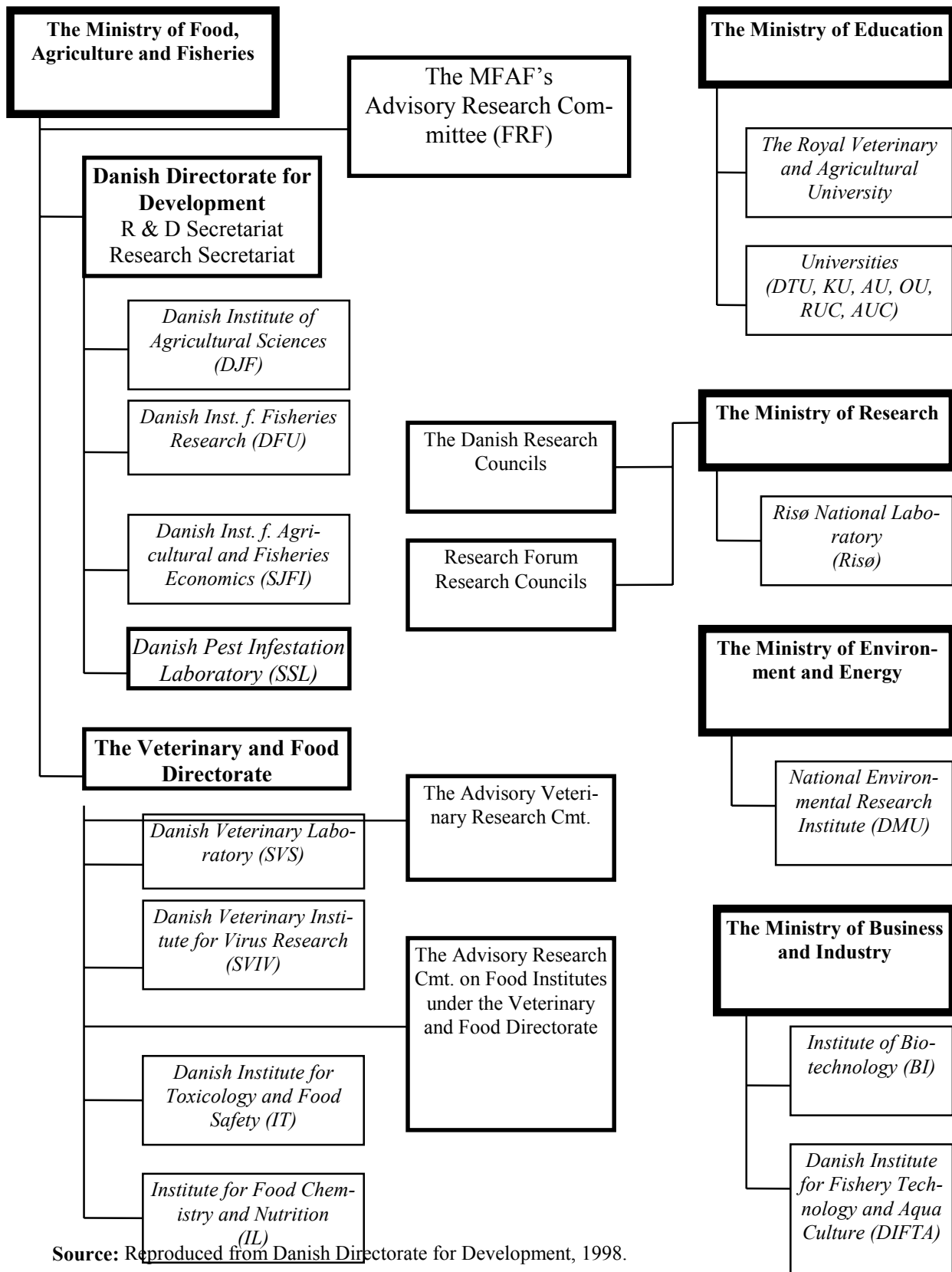
become a model country as a pesticide-free food nation. By seizing this opportunity the detoxification of Danish food products could at once create a unique and lucrative niche while sowing the seeds for a new wave of industrial revival based on agriculture...”

The Research Centre supports research in organic farming for Organic Farming (FØJO). All of the major agricultural organisations and research units (including, for example, The Royal Veterinary and Agricultural University and Risø National Laboratory) are on the board of the Research Centre. At the moment research within the field of organic farming is taking place at 14 institutions.

2.5 Actors and processes

What we shall term the classical Agricultural Policy Network still has a very prominent role to play. The network consists of The Ministry of Food, Agriculture and Fisheries (MFAF) and the main agricultural organisations. The dominant group of farmers are organised in the Farmers’ Union (*De Danske Landboforeninger*) and the Danish Family Farmers’ Union (*Dansk Familiebrug*). Also, the Commercial Farmers’ Union (*Erhvervsjordbruget*) should be mentioned. This Union represents the small group of very large farmers. More recently, the National Union of Organic Farmers (*LØJ*) has come into the picture. The vast majority of farmers are members of the Farmers’ Union or the Danish Family Farmers’ Union, however. The Agricultural Council (*Landbrugsraadet*) is an umbrella organisation representing the three farmers’ unions alongside with the major processing industries. As will be described in the following sections, this network has historically been very powerful and tightly integrated. There are signs to suggest, however, that its influence (which is still very significant) is waning. For example, the former Ministry of Agriculture and Fisheries has now been changed into The Ministry of Food, Agriculture and Fisheries. This not only reflects a recognition of the increasing role of food processing in food production but also signals the intention of including an element of consumer policy in the otherwise strongly production oriented focus of the Ministry. However, the primary reason for reorganising the Ministry was the intention to create a single ministry with responsibility for the whole food chain from production to consumption.

Figure 2.1 The Organisation of Food, Agricultural and Fisheries Research



Source: Reproduced from Danish Directorate for Development, 1998.

A number of actors have a stake in the policies described above. Within biotechnology, the medical industry (NOVO Nordisk) and some of the large food processing companies (Danisco, MD Foods) are major actors⁶. Also, within the seeds industry DLF Trifolium should be mentioned. Industrial interests are sometimes mediated through the Federation of Danish Industries (*Dansk Industri*).

Mention should also be made of environmental organisations such as NOAH (which is part of Friends of the Earth) and Greenpeace Denmark as well as the Society for Conservation of Nature (*Naturfredningsforeningen*), which is by far the largest of these organisations. In fact, with a membership of more than 200,000 it roughly matches the combined membership of all political parties in Parliament. Finally, the Consumer Council (*Forbrugerraadet*) has been defending consumer interests at various levels.

An overview of the organisation of food, agricultural and fisheries research is given in Figure 2.1 above.

2.6 Objectives and Instruments

The Advisory Research Committee of the Ministry of Food, Agriculture and Fisheries (MFAF), in its recent plan, *Strategi 2000*, points to the need to support:

- the adjustment of agriculture to changing market conditions;
- the development of sustainable forms of production;
- the quality of food products.

It therefore recommends a strengthening of research in novel foods as part of a wider strategy to:

- “increasingly focus on security, quality, health and nutritional value of Danish produced or processed foods in order to retain the strong international position of Danish food production
- intensify research in food production which is biologically and economically sustainable and with increasing emphasis on ethics, the environment and the working environment [...]
- to maintain and improve the level of knowledge concerning genetically-modified and functional foods, including knowledge on safety assessments
- to provide research results for the advancement of a new and more adequate development of production technology, including biotechnology, within the food industry.”

(Danish Directorate for Development (*Strukturdirektoratet*), 1998:14-15)

Public concerns are reflected in the strategy’s emphasis on food quality, health, nutritional value, and methods of production.

⁶ In PLS Consult (1997), the following companies are mentioned as important Danish biotechnology companies: Christian Hansens Laboratorium, Novo Nordisk, Krüger, Danisco, Carlsberg, Copenhagen Pectin, and DLF Trifolium.

In its strategy paper, the Advisory Committee pursues a dual strategy of supporting the development of “sustainable modes of production with an optimal utilisation of nutrients and a reduced consumption of pesticides, antibiotic growth stimulants and other non-environmental substances”. The plan also recommends a strengthening of research in novel foods, since “it is expected that “novel foods” will ... increasingly be introduced in the Danish market”.

2.7 National – EU interaction

The most important national-EU interactions are to do with the issue of patenting and labelling. Denmark has sought to pursue a more restrictive policy in these areas than the EU as a whole, but has been outvoted on several occasions.

With Decision 97/35, Directive 90/220 was amended to require labelling of all genetically modified seeds. Denmark supported this Decision because it was seen as an improvement compared to the existing legal basis. However, Denmark has tried to influence the Decision to make labelling requirements cover the whole food chain and not only the applicant. Also, Denmark wanted the Decision to be extended with information on the characteristics added to the organism. Finally, Denmark has tried to influence its implementation in this direction (Danish EPA, 1997a).

After the Novel Foods Regulation came into force in May 1997 Denmark has received notification from Brussels on two oilseed rape products plus some maize products after the simplified procedure according to Article 5 in the Regulation. The DVFA has asked some questions through the European Commission to the applicant but despite this the products have gained authorisation on the European market (interview with Kit Eisner, DVFA, 2nd June 1998). In discussions on Regulation 1139/98 (on the labelling of genetically-modified soya and maize), both industry and some NGOs (NOAH) have opposed labelling with ‘may contain’, arguing that this could undermine well-established principles for labelling, causing more confusion and uncertainty among consumers without offering any real information.

Along with the European Commission, the Danish Minister of Food, Agriculture and Fisheries has promoted the ‘may contain’ label, where it is unclear if raw materials have been genetically modified or not. In his view this would result in the labelling of more products (interview, Kit Eisner, DVFA, 2nd June 98). For other reasons, Sweden and Italy have taken the same stance but have been outvoted by the other Agriculture Ministers in May 1998.

In 1998 the Danish guidelines on genetically modified soya and maize were substituted by Regulation 1813/98, which weakened the Danish labelling scheme. There has been pressure from NGOs to continue the Danish labelling system, but Parliament decided to accept the Regulation no. 1813/98 for harmonisation reasons.

The developments described above are of special significance to organic farmers, since they are not allowed to use genetically-manipulated inputs under the official rules for organic farming defined by the State ‘Ø’ label.

As mentioned above, the labelling controversy between Denmark and the EU is one between

two different perceptions of what information is relevant to the customer. The Danish labelling system has been based (to a higher degree) on the view that consumer relevant information may:

- transcend the physical, chemical etc. properties of the product, and
- include production methods or other socially relevant aspects of the history of the product.

In contrast, the EU system of labelling, which has now overruled the Danish system to some extent, is based on a more narrow view of consumer interest. It is based on the principle of substantial equivalence which implies that consumer relevance is limited to the physical or chemical properties of the product, whereas political concerns about production methods and environmental risks are irrelevant from a labelling perspective.

The 'patenting of life'

The European Parliament has recently approved a common set of rules on the patenting of biotechnological inventions, based on a proposal by the Commission on the legal protection of biotechnological inventions. Advocates of these rules have argued that the absence of such rights in the EU has been a major competitive disadvantage to European companies. Therefore, European companies are said to be lagging behind their American competitors.

As in other countries, the patenting of live organisms has been - and to some extent remains - a controversial issue in Denmark. In the late 1980s there was an intense public debate on patenting living organisms (Toft, 1987; Toft, 1988a and 1988b; Gene Debat, 1988). These discussions were followed by a motion from SF (The Socialist People's Party) in the Danish Parliament in January 1991. All parties requested Government to work for a Danish policy by which

- a ban on patents on humans should be built into the Directive itself,
- a continued product patent on animals should be possible,
- there should be no limitations in 'farmer's privilege',
- biological diversity should be preserved, and
- the interests of Third World countries should be considered.

The first draft Directive on patenting of biotechnological inventions was rejected by the European Parliament in 1995. A redraft of the Directive has recently been accepted by the first hearing of the European Parliament. This gave rise to some public debate in Denmark mainly on the economic and ethical aspects (Toft, 1997; Toft and Porter, 1997a). In the European Parliament Denmark decided to vote for the redraft Directive despite protests from NGOs that many of the Danish conditions were not met (Toft and Porter, 1997b).

2.8 Conclusions

In this section we have defined science, technology and innovation policies as policies concerning the appropriability regime (i.e. patent law, farmers privileges, etc.), technology support and extension, and marketing regulations. While the described policy framework appears unfavourable to the agrochemical industry, it supports the further development of biotechnology for the export markets.

Publicly funded research programmes (FØTEK and BIOTEK) have supported the development of biotechnology in Denmark, and a further strengthening of research in novel foods is recommended. Evaluations of these programmes suggest that, from an industry perspective, especially the application oriented FØTEK programme has been successful. The introduction of genetically modified foods in the Danish home market has been hindered by consumer oriented national labelling practices, however. These conditions have been seen as too restrictive by at least part of industry and agriculture. At the same time, the expansion of the organic farming sector is supported by public research programmes. This sector is currently expanding very rapidly and is in the process of institutionalisation.

In sum, one would expect the policies presented in this section to induce a change of the conventional (non-organic) farming sector towards:

- reducing the use of chemicals and
- increasing the role of biotechnology, while
- stimulating the growth and development of the organic farming sector.

Both elements of the ‘dual strategy’ aim to support the de-chemicalisation of the farming sector. As will be shown below, this tendency is reinforced by the environmental policies pursued at national level.

3. Environmental Protection, Public Health and Biodiversity

Environmental issues have played a prominent part in public debates in Denmark, both in relation to the EU and in relation to agriculture. Until the late 1970s agriculture was largely exempted from environmental policy measures (Daugbjerg 1996; Andersen and Hansen 1991). Farmers were seen by many - and this view was strongly supported by agricultural organisations - as stewards or custodians of the natural environment. Agricultural organisations successfully managed to resist environmental regulation for many years (Andersen, in Andersen and Liefferink, 1997: 263). However, by the early 1980s nitrate pollution - and water pollution caused by the discharge of nutrients in general - began to be seen as a major environmental problem, and the Danish Environmental Protection Agency (EPA) published a series of reports on this subject. It is generally conceded that the environmental reforms of the mid-1980s weakened the traditional position of the tightly knit agricultural policy networks in countries like Denmark and the Netherlands. The agro-environmental conflict resulted in a major change in policy networks and the balance of power between the environmental and agricultural pressure groups. With the environmental issue, the agricultural sector faced a decline in public support (Bager and Proost, 1997: 82). As a result, the traditional near monopoly of the classical agricultural policy network in setting the agricultural policy agenda has been broken.

3.1 Issues

As mentioned in Section 2, some of the main issues relating to the environment are to do with the release of GMOs, and agrochemicals and water policy. Related to these environmental issues are some more directly political issues, such as the possibility of applying the Environmental Guarantee at European level, and the use of green taxes versus statutory measures. Other issues (e.g. the presence of pesticide residues in food products) have been discussed from time to time but have not been the source of many public debates.

3.2 The Release of GMOs⁷

The Danish position on the release of GMOs reflected a general scepticism towards genetic manipulation. Thus, according to a press release from NOAH, the Danish section of Friends of the Earth, (May 1998) 19 Danish non-governmental organisations presented nearly 80,000 signatures against genetically manipulated food, demanding:

- a ban on the production and use of genetically manipulated food,
- a ban on the release of GMOs in the environment,
- a ban on patenting animals, plants and genes.

The number of signatures reflects a popular resistance to the commercial use and development of biotechnology, extending far beyond the ranks of the environmental organisations.

⁷ This section is based largely on Toft (1996a).

This does not seem to have changed much since the mid-1980s, when the 1986 law imposed a virtual ban on field releases. However, in response to EC directive 90/220 on biotechnology, Denmark relaxed its ban with a 1991 revised law. The 1991 Act removed the national opportunity for plaintiffs to object to field releases, though it kept the public consultation procedure. The final decision on market approval was transferred to Competent Authorities (CAs) from all Member States of the EC.

Members of the Danish Parliament feared that Denmark's considerations might not be satisfied and therefore wanted to incorporate the EC environmental guarantee (Treaty of Rome, Article 100A, 4) into Danish law. Accordingly, Denmark's 1991 Act states that the Minister of the Environment "can prohibit marketing or lay down additional conditions on marketing in Denmark, if such marketing would otherwise conflict with safe-guarding significant environment, nature or health interests".

However, when Denmark objected to the first marketing application, for PGS herbicide-tolerant oilseed rape, on grounds of weed-control implications, it was outvoted in the Article 21 Committee in February 1995. The majority rejected Denmark's concern, arguing that it was based on an assumption rather than scientific evidence, as there exists no study on the subject (MoE, 1994).

3.3 Pesticides and Water Policy

Water policy is an important national policy area, first because Denmark, unlike many other countries, relies almost exclusively on ground water for its drinking water supply. Thus, the whole country has been designated a Nitrate Vulnerable Zone (NVZ), and by 1999, land in NVZs will be subject to so-called 'good-practice' measures. The past two decades have seen mounting concerns over the quality of drinking water. While the leaching of nutrients (mainly nitrogen and phosphorus) has been a hot topic in the wake of recurrent problems of eutrophication (oxygen shortage) in the straits, the difficulties of finding ground water supplies not contaminated by pesticides have increasingly come to the fore in recent years.

In 1984, the EPA presented the NPO report (on nitrogen, phosphorus, and organic waste) to Parliament, and in 1985 the so-called NPO *Action Plan* was passed. Since 1982, the legal basis for the regulation of water pollution had been the RKP system, RKP being the Danish abbreviation for Recipient Quality Planning. By this system, a target recipient quality was defined at county level in terms of so-called *immission* limit values. These were then transformed into *emission* limit values, which in turn were allocated to companies and sewage disposal plants at municipal level (Schroll, 1997:176). Under the RKP system, dilution became the paramount strategy for solving environmental problems.

As mentioned by Schroll, environmental regulation was a matter for the Ministry of the Environment, while other ministries did not normally include environmental aspects in their regulation. In 1986 serious problems of eutrophication in the Danish straits, especially catches of dead lobsters in large parts of the Kattegat, aroused a great deal of public attention and made it clear that "there is no place called Away", as Schroll put it. This led to a major strategic shift in environmental regulation, aimed at reducing emissions rather than diluting them. In this

way, the concept of cleaner technology was placed firmly on the political agenda.

The serious problems of eutrophication in the straits implied that the Minister of the Environment put forward an Action Plan on Aquatic Environment in 1986 to reduce the loss of nitrogen. With its 10-point programme, The Danish Society for the Conservation of Nature had played an active part in inspiring this plan. The plan set a target of reducing the loss of nitrogen by 50 per cent, and phosphorus by 80 per cent, before 1992. The Action Plan required a minimum storage capacity for slurry for 5 months and banned the spreading of liquid manure in the period between harvest and the 15th of October, unless fields were covered with crops or about to be planted with winter crops. Finally, “restrictions on manure application were to be settled in negotiations between the Ministry of Agriculture and the agricultural associations” (Daugbjerg 1996: 131).

Also, the use of pesticides came into focus about that time. A considerable increase in the use of pesticides in Denmark had taken place since the start of the 1980s. Simultaneously studies showing the impact of herbicides on bird fauna, soil leaching, and links between pesticides and cancer had been published. All of this caused a great deal of public debate and a demand for further reduction in the use of pesticides.

In 1987 the Minister of the Environment put forward an Action Plan to reduce the application of pesticides. The plan underscored that “due to the considerable difficulties of establishing an environmentally acceptable level of pesticides application ... it is necessary to reduce the use of pesticides as much as possible. However, the existing agricultural production cannot take place without the use of pesticides ...” (MoE, 1997).

The two main targets of the action plan were to reduce the quantity of pesticides used, and shift consumption away from the most harmful pesticides. In concrete terms the Action Plan aimed to reduce the amount of pesticides used by at least 25% before January 1990 (compared with average usage in 1981-1985), and a further 25% reduction was to be attained by January 1997. In order to attain the second objective (encouraging less harmful pesticides), it was decided in 1987 that all existing pesticides were to be reappraised. Moreover, approvals were to be time limited and based on inherent product characteristics (such as carcinogenicity, for example). This new procedure gave rise to a very large number of complaints from the agro-chemical industry, which feared that other countries might follow the Danish example.

In 1990, the Ministry of the Environment made status reports on the two action plans. They concluded that neither of the original reduction targets could be reached by the farming sector (Ministry of Food, Agriculture and Fisheries, 1996). This spurred another round of public debate and made Government put forward its Action Plan for Sustainable Farming in 1991 (The Ministry of Agriculture, 1991). It should be noted that the so-called green majority in the Danish Parliament initiated the two action plans.

In the Action Plan for Sustainable Farming the target of reducing the loss of nitrogen was to be attained by improving the use of nitrogen in manure, while integrated pest management and production systems were introduced to reduce the effect and use of pesticides. Consequently, a research programme was launched to gain more knowledge on the use of forage and reduced use of pesticides on the basis of mechanical weed management. ECU 5 m was spent on the

research programme in 4 years. Both targets were to be reached without any significant effects on farm incomes. A number of other measures have subsequently been added to reach the targets from the action plans for pesticides. For example, farmers have been required (since 1993) to keep spraying journals.

Although reductions in the application of pesticide did not meet the original targets, the various measures were not without any effect. Thus, agriculture's expenditure on pesticides amounted to 7.7 per cent of the total value of plant production in 1996. Since 1996 there has been a 15 per cent levy on herbicides and fungicides and a 37 per cent levy on insecticides and soil disinfectants. In 1997 the total revenue from these taxes amounted to ECU 31 m - or about ECU 500 per farm unit. Sales of active materials have gone down steadily since the early 1980s by about 40 per cent, and attempts at measuring the environmental load (by taking account of the toxicity of the chemicals in question) confirm that the environmental load has indeed been eased (Gravesen, 1998).

Nevertheless, in 1997 the failure of the Action Plans on the Aquatic Environment and Pesticides to reach their goals again became a hot issue. The government initiated a new (second) Action Plan on the Aquatic Environment aiming at a 100,000 t reduction of nitrogen from farm fields and supporting a shift from traditional agriculture to organic farming as a means of reducing the environmental burden from agriculture.

The Drinking Water Committee (DWT) stated in its report of December 1997 that we should aim to maintain the capacity to produce unpolluted drinking water from untreated ground water. At the moment this is not possible all over the country. The DWT therefore recommends a strengthening of the monitoring of ground water quality. Also, in the spring 1997, Parliament passed a motion encouraging Government to establish an expert committee to examine the implications of abandoning the use of pesticides within agriculture altogether. Subsequently, the Minister of the Environment in August 1997 set up the committee. It is chaired by Mr Sven Bichel, former president of The Society for the Conservation of Nature and is due to report in the spring of 1999.

3.4 The Environmental Guarantee

As mentioned above, one of the most important political issues, both in relation to environmental policies and in relation to Danish attitudes to the EU generally, has been the so-called Environmental Guarantee (Article 100A of the Maastricht Treaty). The Environmental Guarantee played an important part in public debates preceding the referendum on the Single European Act in 1986, on the Maastricht Treaty in 1992, and on the Treaty of Amsterdam in 1998. For example, one of the declarations issued at the Edinburgh Summit on Denmark's ratification of the Maastricht Treaty concerns Denmark's rights to maintain environmental standards above the EU level.

Some discussions have focused on the judicial aspects of the Environmental Guarantee. Thus, before the 1986 referendum, it was argued by the Danish Ministry of Foreign Affairs that, according to the guarantee, each Member State would be at liberty to set its own environ-

mental standards above those of the European Union as long as this would not discriminate against products from other Member Countries, thereby violating the principles of the Open Market. Some years before the Single European Act, the EC had forced Denmark to abandon a national system of regulations on the labelling of chemicals. Against this background: “The one-sided focus on creating an internal market gave the impression that the EU would sacrifice environmental standards for trade and economic growth”, as Andersen (1997) observes.

After the PCP case (on a German product for wood protection), the Danish Ministry of Foreign Affairs admitted that the guarantee does not apply to the introduction of new and stricter standards in areas which are harmonised (Ministry of Foreign Affairs, 1994). It is not possible to anticipate the practical implications of the Guarantee until the Commission has set a precedent. It seems clear, though, that a national political preference for higher standards will not suffice to justify the use of the guarantee.

Nevertheless, the positions from the 1986 referendum have changed. Today, many environmentalists would argue that since the scope of many environmental problems, such as air pollution, is global or at least international, the solutions to these problems must be international as well. Environmental NGOs have therefore supported the idea of giving the European Parliament decision-making powers on environmental issues. Environmental problems were almost as global in 1986 as they are today, of course. But while in 1986 the EC was feared by Danish environmentalists to “sacrifice environmental standards for trade and economic growth” (Andersen, 1997), the European Union is now increasingly seen as an arena for coalition building on a number of issues, including the environment.

Environmental policy-making within the European Union has been characterised by a ‘leader-laggard dynamic’ with the ‘green troika’ consisting of Germany, the Netherlands and Denmark (Sbragia, 1996) as leaders. No doubt, the three new member countries (Sweden, Finland and Austria) should be included in this group (cf. Andersen and Liefferink, 1997). More generally, policy innovation - like other evolutionary processes - appears to contain an element of variation that could be sacrificed by a strong commitment to harmonisation. Some would argue, therefore, that a combination of common minimum standards supplemented by national regulations might provide a more dynamic framework for policy innovation and learning than a uniform policy across the European Union.

Denmark has not always been a forerunner on environmental issues, however. Grant (1997: 204) after observing that “European environmental policy has been driven by three vanguard states: Germany, Denmark and The Netherlands”, went on to argue that

“Their role helps to explain the relative lack of progress in adjusting agricultural policy to give a greater weight to environmental concerns. Both Denmark and the Netherlands have too many interests bound up with intensive agriculture. Germany remains a key actor and receives 20 per cent of all the EU funds available for agri-environmental programmes.”

The farming sector is often said to have responded much more slowly to environmental regulations than industry (Munk Christiansen, 1992). The reasons for this are complex and may include several variables. One can think of the political strength of the agricultural organisations and the difficulties of small enterprises like family farms in handling bureaucratic com-

plexity. Other reasons are the costs of controlling an industry with many small units (and the incentives or disincentives of local municipalities to do so) or farmers' lack of appreciation for the need for environmental regulations⁸.

Whatever the reasons, this has led some to argue that "industry has tidied up after itself; now we are waiting for agriculture to follow suit." This line of argument is (implicitly) addressed by the Agricultural Council in its Internet presentation of the Danish farming sector, where it is pointed out that pesticides make up only a very small fraction of the chemical load on the environment. Furthermore, the Council argues that the present system of levies induces farmers to substitute more toxic for less toxic sprays, rather than vice versa.

Agricultural organisations have consistently opposed green taxes, advocated by environmental economists (Daugbjerg, 1997b). Partly as a result of this, these organisations have had to accept more and more statutory regulations on all kinds, such as regulations on the minimum storage capacity for slurry, on 'green fields' (i.e. maintaining crop cover) in the autumn, on fallowing and on the application of organic fertilisers. But also regulations on the number of animal units per hectare, on plans for the use of pesticides and fertilisers, and on crop rotation and on uncultivated margins along watercourses were implemented.

In short, the bureaucratic load has increased. For example, the following measures have been introduced to fulfil the goals of the Pesticide Action Plan:

- A ban on plan spraying.
- Compulsory training/spraying certification.
- The possibility of prohibiting spraying.
- Maximum limits on the environmental impact of pesticides.
- Approval of spraying equipment.

A reaction has set in, especially in West Jutland, where farmers have organised to protest against the increasing burden of regulation. Despite this, agricultural organisations have not managed to avoid the introduction of levies. As already mentioned, there has been a levy on herbicides, fungicides, insecticides and soil disinfectants since 1996. All of these measures undoubtedly have benefited the environment.

3.5 Actors and Processes

Not surprisingly, many of the actors mentioned in Section 2 (on science, technology and innovation policies) also have a stake in the environmental regulation of agriculture. This applies, for example, to the agricultural policy network, consisting of The Ministry of Food, Agriculture and Fisheries and the main agricultural organisations.

In connection with the release of GMOs, the agro-chemical industry has been very active. Environmental NGOs such as NOAH (Friends of the Earth, Denmark), Greenpeace Denmark

⁸ According to a survey conducted by Bager and Søgaard (1994:117), "most farmers perceived environmental problems as secondary compared to a range of other problems". In contrast, two-thirds of all farmers mentioned "bureaucracy and paper work" as one of the three most important problems faced by Danish farmers.

and the Society for Conservation of Nature (*Naturfredningsforeningen*) have all been seeking to defend environmental interests.

Over the years The Ministry of the Environment and The Environmental Protection Agency have become very powerful. In 1993 The Ministry of the Environment merged with The Ministry of Energy, and the Ministry of the Environment and Energy is now considered one of the 'heavyweight' ministries, ranking above - for example - the Ministry of Food, Agriculture and Fisheries or the Ministry of Business and Industry.

3.6 Procedures used to complete the policy-making process

Before introducing transgenic crops intended for human consumption, both the environmental and health/safety effects have to be assessed by two separate Danish Authorities. The approval of genetically-modified products is mandatory before marketing.

The Environmental Protection Agency (EPA) is responsible for the environmental part of this assessment. Depending on the type of notification, the EPA consults: the National Forest and Nature Agency or the Ministry of the Environment, the Institute for Food Security and Toxicology, the Danish Plant Directorate, or the Ministry of Food, Agriculture and Fisheries.

The Danish Veterinary and Food Administration (DVFA), under The Ministry of Food, Agriculture and Fisheries, is responsible for the health/safety assessment of products for human consumption. In contrast to the environmental assessment, the health/safety assessment is made without any formal consultation of other authorities or interest groups. The safety issue concerns all food aspects, including pesticide residues if relevant.

This system of separate regulatory procedure has been in force since 1986 when Denmark adopted the Act on Gene Technology, several years ahead of the EC Directive. In focus then was the environmental questions and not, for example, questions of food safety. Until 1997 this was reflected in the formal involvement of Parliament in the decision making on environmental assessment, whereas Parliament was not formally involved in the health/safety assessment. The Danish health/safety approval procedure changed in 1997 to involve both interest groups for consultation and Parliament before the Minister's decision is finally taken.

Since then there has been no real discussion on the boundary issues between Ministries, Parliament and the public. The responsibility for food has now moved from The Ministry of Health to the newly created Ministry of Food, Agriculture and Fisheries.

The Danish environmental approval procedure involves both interest groups - industry and NGOs - and the Danish Parliament (Toft, 1996a). In 1997 Parliament expressed a wish to be informed at an earlier stage on different EU initiatives in order to be able to influence these initiatives. This implied a stronger involvement of the Special Interministerial Committee for the Environment where various interest groups are also represented. In this way the Special Committee on the Environment works as an interdepartmental committee as it also has different ministries among the members (Højbjerg and Marcher, 1995).

As concerns GMO risk assessment, Denmark, unlike the UK, has not developed any special methods. The risk assessment starts with the plant and then goes on to consider a series of questions regarding its inherent characteristics and use. If, for instance, genetic transfer to other organisms is possible, the risk assessment addresses the possible consequences of a transfer. The genetically-modified plant is compared to a non-genetically-modified plant and to the existing environment and agriculture. Hence, human practices are also relevant to the assessment (interview Hans Erik Svart, the National Forest and Nature Agency, May 1998).

The Danish Ministry of the Environment has attempted to build up its own expertise for regulating GMO releases, especially by funding bio-safety research, with an annual budget of approximately ECU 1m. Most of this research investigates safety issues pertaining to the present use of gene technology, though some also anticipate future technological developments. The research is designed mainly to support the administration of the Act; the projects have clear links with concrete regulatory problems.

3.7 Controversies and problem-definitions

As will be described in Subsection 4.4 below, unilateral national measures to protect the environment (e.g. by internalising the external costs of agricultural pollution) are feared by the farming sector to distort the terms of competition. Both the leading agricultural organisations and the Liberal Party, *Venstre*, which has traditionally supported agricultural interests in Parliament, have given up their initial strategy of almost automatically opposing measures to protect the environment. This has caused conflict between the (agricultural) rank and file membership and the top level of these organisations.

For example, in many local sections of the Farmers' Union, there is still a great deal of hostility to environmental measures. A small symposium conducted by the agricultural magazine, *Landsbladet* (16th of January 1998), with eight chairmen of local branches of the Farmers' Union, revealed considerable frustration about the growing tensions between the farming sector on the one hand and the political system, the press, and probably a majority of the population⁹ on the other.

In a newspaper interview one local chairman expressed that "many of our members feel that our organisation has been far too amenable to negotiation and that now it must be enough" (Jørgen E. Petersen, chairman of the Salling division of the Farmers Union, *Information* 17th January 1998). Many farmers felt betrayed by the Liberal Party when it supported the second Aquatic Environment Plan in Parliament just before the election in May 1998, and some farmers publicly advocated taking revenge by voting for the small Christian People's Party¹⁰. On the previous election this party had failed to obtain the two per cent of the votes required

⁹ According to a recent opinion poll approximately two in three Danes agreed that "Denmark should endeavour to convert to organic farming."

¹⁰ In an historical perspective this is somewhat surprising, since the Christian People's Party was often part of the so-called green majority of the opposition under Poul Schlüter's minority governments in the 1980s. From 1982 to 1988 the Christian People's Party's only portfolio in the minority government, Christian Christensen, was Minister of the Environment (Andersen, 1997).

for representation in the *Folketing*, but this time it passed the limit.

3.8 National – EU interaction

Since the passage of the 1986 Act on biotechnology, and especially perhaps since 1993 following the shift in Government, Denmark has tried to influence EU policy as strongly as possible. Thus, since 1994 Denmark has advocated a labelling of genetically-modified food in relation to directive 90/220. Together with other Member States Denmark seems to have persuaded the Commission to suggest labelling that would make it possible to trace a crop from cultivation to all subsequent stages before it (or part of it) ends on the consumer's table.

Furthermore, Denmark has been advocating for many years that the 'secondary effects' of a genetically-modified crop should be part of the assessment according to 90/220. Secondary effects include the impact of herbicide-resistance on the pattern of herbicide use and the environmental implications thereof. Denmark has also advocated that the EU undertake a thorough evaluation of the long-term environmental consequences of using herbicide-resistant crops, e.g. of growing several crops with diverse resistance.

The EPA has initiated general studies on the subject of risk, including secondary effects. Denmark has not conducted any national environmental studies or risk analyses on the use of modified Bt-endotoxins for the management of insects, as the Ciba-Geigy maize will not lead to the development of a general resistance to the Bt-endotoxins. This is also the reason why Denmark would not initiate a European study but would support such an initiative from other Member States (The Minister of the Environment, 1996).

For environmental regulation, the possible impact of herbicide-resistant crops is assessed on a crop-by-crop basis (including secondary effects). The Danish stance depends on the crop, the 'weediness' effects of the crop and the herbicide and not on whether some weed control is available. The underlying idea is that new products should provide better solutions to existing environmental problems, not the opposite. In practice this means that for some crops - fodder beet and maize for instance - Denmark accepts existing agricultural practices as a normative baseline for the potential environmental impact of transgenic crops while for other crops - oilseed rape, for instance - this is not the case.

For genetically-modified plants, research projects compile a catalogue of methods for ecological risk assessment, review methods for studying competition and establishment, and suggest where new test procedures need to be developed for risk assessment (Kjellsson and Simonsen, 1994, Kjellsson *et al*, 1997). Related projects develop test systems for such plants, and methods specifically for the field testing of the PGS herbicide-resistant oilseed rape in 1993-1994 (Jorgensen, R.B. and Andersen, B., 1994) The PGS case led the Ministry of the Environment to initiate a literature study on the environmental consequences of herbicide-resistant plants (Bjerregaard *et al*, 1997).

This study was followed up by another one on the modelling of herbicide use in genetically-modified herbicide-resistant crops. The aim of the project is to investigate the consequences on herbicide use of growing genetically-modified herbicide-resistant crops to predict under

which circumstances these plants are likely to cause environmental problems. In the first part of the study information was gathered to be used in models that simulate the use of genetically-modified herbicide-resistant plants in different crop rotation systems (Madsen, K.H. *et al*, 1997).

The use of microbial pest control is expected to increase in the future with *Bacillus thuringiensis* as the major microbial pest control agent. Therefore, the National Environmental Research Institute and the Royal Agricultural and Veterinary University did a project with the objective to increase knowledge concerning environmental effects caused by microbial pest control agents (Hansen, 1996).

Three different agencies in the Danish Ministry of Environment and Energy - the National Environmental Research Institute, the EPA, and the National Forest and Nature Agency - are working on a project to work out protocols for risk analysis for some specific inserted genes. These protocols will contain a closer specification and description of the different potential effects, on both target and non-target organisms.

The National Forest and Nature Agency has published a series of monographs on different relevant crops that is relevant for genetic engineering. In this way they collect information on the different crops to prepare a comparison with the genetically modified crops.

At the time of writing, the EPA is considering how to make priorities on risk assessment relevant not only to the regulatory issues but also to the general national research policy under consideration. Annex II in the draft for a revised 90/220 is a good platform for research priorities linked to the regulatory issues. The ideal situation would be for the needed research in relation to a specific GMO to start at the same time as the approval of the first field release to have the results ready when a marketing application is received (interview, Holger Petersen, EPA, 5th May 98). This is an ideal situation, however, as the authorities often have difficulties getting access to genetically-modified crops from abroad, because companies are often unwilling to co-operate.

3.9 Conclusions

Environmental protection is one of the most powerful national policy areas in terms of influencing the markets for GMOs and agrochemical products. In Denmark this policy area is central both to discussions concerning Denmark's relations to the EU and, in particular, in relation to the farming sector.

Without doubt, statutory regulation (rules, bans, requirements) is by far the most important form of regulation. However, there seems to be a growing opposition to this type of regulation within agriculture, and there are signs to suggest that increasing emphasis will be placed on other elements such as normative regulation (information, education, and - not least - agricultural extension). Also, with levies on the use of pesticides, the use of economic incentives has been introduced and may become more important in the future.

4. National Farm Support and the CAP

On Denmark's joining the EC in 1973 practically all agricultural subsidies were replaced by EC support. Thus, while (national) agricultural support amounted to some 4.6 per cent of total government spending in 1968, the corresponding figure for 1976 had dropped to about 0.4 per cent¹¹ (Just & Omholt, 1984:185). According to Nedergaard, Hansen & Mikkelsen (1993), the Danish level of support amounted to some 3 per cent of the value of agricultural production in 1988, less than half the level of countries like Germany, France and Italy. The reasons for this modest level of national support appear to be consistent with the general pattern of national farm support presented in Munk (1994), who found that transfers to agricultural producers are negatively related to the share of net agricultural exports in agricultural production.

As a result national farm support is practically a non-issue in the public debate in Denmark. National farm support (except perhaps for the conversion to organic farming) appears to be overshadowed by other economic factors such as the environmental regulations discussed in section 3, legal constraints on structural development, or tax issues (most notably depreciation allowances).

In the subsections under 4.1 we shall therefore confine ourselves to giving an overview of the most important items in terms of their possible consequences for the PITA project. Furthermore we shall focus on the much more important role of the CAP in the remainder of this section.

4.1 An overview of national farm support

Following the Annual Report 1996 from the Ministry of Food, Agriculture and Fisheries, national farm support policies in Denmark are directed at structural development and organic farming, agricultural extension and product development.

EU market regulations are by far the most important items in the Budget. The second most important item concerns "structural support and efficiency improvement". This includes investment support for the improvement of farms under Law no. 479 (12th June 1996) on Support for Structural Development and Organic Farming etc. About 17 per cent of this money was intended for organic production and other forms of environmental support (e.g. for "environmentally-friendly measures" such as a reduced use of nitrate, environmentally-friendly management of grass areas out of rotation, 20 year set-aside or spray-free marginal zones). Also, under consolidate Act no. 1172 (16th December 1992) subsidies may be granted for "environment-improving investments in small farm units" (e.g. common bio gas systems, silage containers, etc.).

¹¹ By comparison, the EC support for 1976 amounted to some 4.1 per cent of Government spending.

Agricultural extension.

Following a revision of the law, which came into force on January 1st 1997, increased emphasis has been placed on advising young farmers and farmers converting to organic farming. As mentioned in Chapter 4, the role of extension in influencing farmers' environmental behaviour is increasingly recognised.

Product development

The legal basis for supporting product development is consolidate Act no. 617, 18th July 1995, on subsidies for the development of products and markets within the primary sector; product- and market development in processing and improvement of agricultural and fish products; and a collective promotion campaign for agricultural and fish products.

This item finances the MFAF's share of the FØTEK programme and also supports marketing and market development of new food products. Similarly, the development projects within the organic sector is subsidised (based on the Action Plan for the Promotion of Organic Food Production, 1995).

National farm support measures should be seen in the light of the main intentions of agricultural legislation. In a recent report from the Committee Concerning Structural Development Within Agriculture, these are divided into two main groups. One group pertains to the farming sector per se:

- to promote structural change in order to secure the international competitiveness of the farming sector while preserving a variety of farm types, including full time as well as part-time farms;
- preserving owner-occupation and family farming as the dominant forms of ownership;
- securing a proper utilisation of farm land.

The second group of purposes concerns to do with wider social issues such as:

- protecting the natural environment and rural amenities;
- preventing depopulation of rural areas and discouraging remote ownership.

4.2 The position of Danish agriculture in the EU

In the late 19th Century Denmark, like the Netherlands and some of the British dominions, became integrated into what has been termed The Imperial Food Order, supplying the British home market (Marsden *et al.*, 1993). Hence, Danish food production became strongly export oriented. This historical background, in conjunction with existing market positions and technological capabilities, as well as the relatively modest level of national farm support, suggests that Denmark would enjoy a comparative advantages in food production, even under a pure free-market regime.

The export subsidies of the CAP, which have made up more than 10 per cent of the total value of agricultural exports, have doubtless contributed very significantly to this development. It has been claimed that, historically, the CAP with its milk, meat and cereals regimes, was designed for an agricultural structure like that of Northern France (Nedergaard, Hansen & Mikkelsen, 1993: 373). With an almost identical structure, the Danish farming sector was

perfectly posited to gain from the CAP. An obvious case in point was the so-called “feta adventure” in the Middle East. The Danish production of feta cheese, based on cow milk, really took off in the mid-1970s. From 1977 to 1991 production increased from 37,000 to 98,000 tonnes, slightly more than one third of Denmark’s total cheese production. The bulk of this production was sold in the Iranian market, heavily subsidised by export subsidies from the EC (Søgaard, 1994). On the whole Denmark (again like the Netherlands) has been a major beneficiary of the CAP (Buckwell *et al.* 1982, Brown 1988, Harrison *et al.* 1995).

4.3 Agricultural policy reform issues

Against this background, it is hardly surprising that the liberal winds at EU and GATT/WTO levels have forced the national agricultural policy network to redefine Danish agricultural interests. Recent Danish political initiatives have been based on current strong demands with respect to consumer protection and product quality, environment and nature, workers protection and animal welfare, combined with a gradual market orientation and limitation of price support (The Ministry of Food, Agriculture and Fisheries, 1997a). Trends in the CAP reform that run counter to Danish agricultural interests include the reduction of export subsidies, the process of decoupling, and the (anticipated) tendency to renationalisation.

In the following section, the position of the national agricultural policy network (i.e. the Government and the main agricultural organisations) as well as the attitudes of the general public on these issues will be considered. Unlike the environmental, health, animal welfare, and safety aspects of food production, public interest in international trade liberalisation has been scant and largely confined to those affected by the outcome of the process of liberalisation. As a result, the traditional agricultural policy network still enjoys a near monopoly in defining the Danish policy on trade liberalisation.

4.4 The changing position of the national agricultural policy network

When the MacSharry reform was introduced in the early 1990s, Denmark, Belgium and the Netherlands at first opposed the reform plans.

“They neither liked the Commission’s radical price cuts nor were they pleased with the idea of giving full and permanent support to farmers. Instead, they argued that the settings of the existing policy instruments should be adjusted in the arable sector by cutting prices but without introducing new instruments for direct payments”

(Daugbjerg 1997a: 25).

These countries preferred what Daugbjerg (following Hall (1993)) describes as a first order change of policy. A first order change is one that leaves objectives, instruments and policy principles unaffected while adjusting instrument settings, or levels. However, “when they realised that there was no chance of changing the overall idea in the reform proposal, they joined the majority” (Daugbjerg, 1997a). The 1997 document from the Ministry of Food, Agriculture and Fisheries (MFAF, 1997a) on the future of the CAP mentions the proposal put forward by Denmark for the Intergovernmental Conference (on the Amsterdam Treaty), concerning a new wording of Article 39 of the Treaty:

“This proposal, which is part of the Danish environmental package, consists of keeping

the existing provisions on productivity, living standards for the agricultural population, stable markets guaranteeing supplies, and fair prices for consumers. However, it adds the demand for a sustainable basis to production, a higher level of protection for nature and the environment, workers protection, and animal welfare, and that consumers must have access to healthy food of high quality.”

The 1997 document describes the challenges faced by agriculture due to the liberalisation of world trade and the likely inclusion of Central and Eastern European countries (CEECs) into the EU. As concerns the accession of new Member States, it concedes that this will “inevitably entail a much more difficult competitive situation for the primary sector on the internal market”, but this, it is added, “is the price which Denmark and the other EU Member States will be prepared to pay.” It is seen as “very important” that the agricultural area does not complicate and protract the enlargement negotiations. Hence, the political interest in the process of enlargement is given priority over agricultural interests. However, the paper points to the need for “a special effort [...] to give the Danish agricultural sector the best possible conditions for developing and maintaining its competitiveness” by means of quality improvements to reduce competition with the agricultural sectors of the new Member States in bulk markets.

The Danish Government and the agricultural organisations are aligned in their fear of renationalisation. Within the EU, Denmark have traditionally emphasised the benefits of free trade under the umbrella of the Common Agricultural Policy, warning against the distortionary effects of a renationalisation of agricultural support. It was very clear, especially during the 1980s that Denmark stood to lose in a “competition among the Treasuries” (Bernstein, 1994: 36). In other words: a renationalisation of agricultural subsidies would lead to unequal - and unfavourable - terms of competition, which would conflict with Danish agricultural export interests. This fear of renationalisation can be found in a number of other documents, both from the Ministry of Food, Agriculture and Fisheries (MFAF) and from the Agricultural Council (The Ministry of Food, Agriculture and Fisheries, 1997a). In other words, if liberalisation at EU and WTO level gives rise to a renationalisation of agricultural support, the Danish position within the EU will be that national support measures should be decoupled as far as possible.

The Danish agricultural and export interests in equal terms of competition also apply to environmental regulation. With strong domestic pressures for improved environmental protection and the possibilities of subsidising agriculture for structural and environmental purposes within the WTO (“The Green Box”) after 1999, the strategy of opposing environmental regulations (which appeared to be the dominant strategy in the 1980s¹²) has been replaced by one of seeking to obtain higher and equal standards throughout the EU (The Ministry of Food, Agriculture and Fisheries, 1997a).

The position of the agricultural organisations does not differ substantially from the official Danish position. Thus the Agricultural Council, in a letter to the Minister of Agriculture (of 8th April 1998b), expressly supported the general tendency in the Commission’s reform pro-

¹² The former president of the Agricultural Council forcefully rejected the very notion of agricultural pollution, arguing that it reflected “a Marxist way of thinking” (Andersen and Hansen, 1991).

posal under Agenda 2000 as well as the policy of EU enlargement. However, the Council voices concerns about insufficient income compensation (of about 50%), the possibility of a differential treatment of farmers from different member countries, and the “proposed undermining of the intervention system for cereals”. Deep concerns are expressed on the issue of cross-compliance, which “will only be acceptable, provided it results in common environmental aims and uniform rules of sanctioning applying to all farmers throughout the EU.”

In sum, the national agricultural policy network has moved from a position of opposing a liberalisation of the CAP as well as environmental regulations to a more sophisticated one of supporting, in principle, the general liberalisation of world trade, accompanied by higher environmental standards at EU level, while expressing concerns about the income effects on farmers, stressing the need for gradual reform and/or compensation, and the possible renationalisation of farm support, which - if it cannot be avoided - should be decoupled.

Ockenden & Franklin (1995: 32), comparing the Dutch and Danish response to the 1992 reforms summed up the general attitude to these changes very well.

“In general both Denmark and the Netherlands have adaptable agricultural sectors and traditions of economic liberalism which make them potentially receptive to further change. Dutch development has been almost self-consciously based on products covered by only light CAP regimes, while the Danish farming industry has responded quickly to the changes induced by the 1992 reforms. In both countries the reforms have been accepted as necessary if not greeted enthusiastically.”

The strategy change described above should be seen as part of a wider change in Danish attitudes to environmental regulation at EU level. Whereas the focus has traditionally been on the possibilities of opting out to obtain or retain higher environmental standards at national level, the EU is increasingly seen as an area for coalition-building (Andersen and Liefferink, 1997).

4.5 Public pressures

The strategic change outlined above should be seen in the light of international developments as well as domestic pressures. The attitudes of the general public (i.e. outside agriculture) vary a great deal, of course, so that any attempt to sum of those attitudes is liable to be biased. Nevertheless, it may be said that:

- The level of subsidies under the CAP (and its disproportionately high share of the EU budget) has long been criticised. The subsidies are often seen as a source of international dumping which is particularly harmful to countries such as the Central and Eastern European Countries, and as a very expensive way of supporting the incomes of large farmers, who would probably be well off anyway.
- Environmental groups have criticised the implications of supporting highly intensive and specialised farming systems, and subsidising animal husbandry.
- The price support system has been said to reduce sensitivity to consumer demand, enabling food producers to focus on the quantity rather than the quality of output.
- Some have been critical of the implications of the CAP for third world producers (e.g. sugar producers suffering from the destabilising effects of the sugar regime).
- Occasionally, CAP-related fraud problems have been debated.

- The CAP is rarely defended, except by debaters with an agricultural background. These sometimes stress its success in achieving self-sufficiency at European level.

As mentioned above, agricultural trade liberalisation has mainly been an issue for agricultural organisations and related circles. The position of the Liberal Party (*Venstre*) is of special relevance here, since the traditional basis of the Liberals has been the farming community. In the wake of an electoral crisis in the 1970s, it became clear to party leaders that with a dwindling number of farmers, a political strategy based on the unilateral defence of farm interests would be suicidal for the party in the long run. The former party leader, Uffe Ellemann Jensen, has repeatedly made it clear that the inclusion in the EU of the former democracies of Eastern Europe is more important, from the perspective of the Liberals, than the protection of national farming interests.

4.6 Concluding remarks

To sum up, the level of national farm support in Denmark is relatively modest compared to many other countries, and in quantitative terms national farm support is clearly overshadowed by other factors such as CAP market regulations or national tax issues such as depreciation allowances.

Denmark's position on the reform of the CAP and on international trade liberalisation has been somewhat ambiguous. As stressed in the introduction to this Chapter, Denmark has traditionally been a net beneficiary of the CAP and therefore supported the high-price system more vigorously than countries like Britain and Sweden (Grant, 1997), at least in the early stages of the reform process.

However, the necessity of reform has been recognised for many years by the agricultural organisations as well as by the Ministry. Within the EU, Denmark has supported the process of liberalisation, albeit with the proviso that a renationalisation of agricultural support should be avoided or at least decoupled, as mentioned above. The agricultural sector in Denmark has found itself squeezed between the need for equal terms of international competition on the one hand and (domestic) environmental pressures on the other. However, with the growing international attention given to environmental problems and the possibilities of subsidising agriculture for structural and environmental purposes within the WTO ("The Green Box") after 1999, the initial strategy of opposing environmental regulations has increasingly been replaced by one of seeking to obtain equal standards at a high level throughout the EU.

5. Interactions

As shown in the previous sections, the national policy framework for innovation within the agrochemical, biotechnology and seeds industries covers a wide range of policies. It involves the Ministry of Food, Agriculture and Fisheries, the Ministry of the Environment, the Ministry of Industry and Business, the Ministry of Research, and a range of other public and private actors. The absence of any central co-ordination is bound to give rise to a number of inconsistencies at all levels. However, to the extent that the science, technology and innovation policies and the policies presented in Section 3 on environmental protection, public health, and biodiversity encourage a move away from pesticide use, they will all be unfavourable to the agrochemical industry in terms of reducing the markets and increase the demand for market alternatives. This is an important common denominator of the policies described above.

5.1 Gaps and inconsistencies between policies and market-related factors

In general, there is a tension between Denmark's interests as a major food exporting nation and its role as a 'forerunner' on environmental issues. Section 2 described the Danish reservations against GMO releases and the national labelling requirements (which have now been harmonised). These policies appear to have presented serious obstacles to the introduction of genetically modified products in the Danish market, which has probably hampered the development of such products in Denmark. This clearly runs counter to the Advisory Research Committee's aim of advancing biotechnology.

Environmental regulations and requirements should not be seen as directly opposed to innovation, however. In some cases national regulations, forcing domestic companies to innovate, may give them a competitive lead by anticipating similar restrictions at a later stage at EU level or in other parts of the world.

Similarly, despite the undeniable tensions between agricultural interests and environmental protection, it would be premature to think of national agricultural interests as being diametrically opposed to environmental protection. As explained in Section 4, the Danish farming sector has an overriding interest in equal terms of competition in the international markets, but it does not have an interest in competition on the basis of price alone. Other parameters, such as environmental criteria, which are difficult for low-cost competitors to meet, may actually be a competitive advantage from the point of view of the Danish farming sector. Therefore, future regulations at EU and WTO level will have a very significant impact on the competitiveness of Danish food products.

There are conflicts between environmentalism and competitiveness, of course. For example, if a leading edge in biotechnology is seen as a precondition for long-term competitiveness, the popular and political opposition to biotechnology in general may put Denmark at a disadvantage. The alternative strategy, of converting the whole - or even a substantial proportion - of the Danish farming sector to organic farming, seems dangerous from a commercial perspective. Although there is currently a shortage of organic food products in the Danish super-

markets, the process of conversion would at best have to be quite protracted.

Furthermore, present perceptions of what is environmentally acceptable and what is not may change. For obvious reasons, the future ‘environmental discourse’ is difficult to discuss with anyone committed to the present version of this discourse. The organic sector is in a process of institutionalisation, and attitudes within this sector are changing¹³.

The relationship between free trade and environmental protection is complex. In theory, free trade would favour agricultural production in countries and regions enjoying natural comparative advantages in food production. In general this may benefit the environment. Thus, a reduction of farming intensity within the European Union might contribute substantially to alleviating the environmental problems from farming. Indeed, opposition from environmental groups to the intensive farming systems encouraged by the ‘old’ CAP has been mentioned as one of the factors behind the need for reform (Köster and Tangermann, 1990)¹⁴.

Still, it would be misleading to think of trade liberalisation as a panacea for solving environmental problems. In economic terminology, the fact that environmental problems represent externalities - i.e. social costs not taken into account by individual producers - will lead to a socially inefficient allocation of resources under a free-trade regime. For example, in the absence of environmental regulation, the most fertile soils may exhibit comparative advantages in plant production, pushing animal husbandry to environmentally more vulnerable soils, as it has happened in Denmark where livestock production is heavily concentrated in the sandy regions of West Jutland.

There is a conflict between adherence to the precautionary principle and the requirement that trade barriers should be based on scientific evidence. Many new technologies (precisely because they are new) are characterised by genuine uncertainty that cannot be assessed a priori in terms of actuarial risk. There may be a wide gulf between proving that a product or a process is dangerous and proving that it is not may. A strict adherence to scientific evidence is liable to be a dangerous strategy, therefore. But then, a relaxation of this requirement could open a Pandora’s Box of trade barriers.

In a previous section we have touched upon the political dynamics of ‘leaders’ and ‘laggards’ within the EU. This points to a tension between harmonisation efforts and policy innovation efforts. On the one hand the recognition that ‘pollution does not respect borders’ provides an important argument for common standards and harmonisation. On the other hand American studies of policy change (in relation to air pollution) has shown that the interaction between

¹³ In Bager and Søgaard (1994) all respondents were distributed along an attitude scale ranging from strongly conventional views, supporting “conventional” farming practices, to highly “alternative” views, supporting the criticisms levelled against the conventional sector. Not surprisingly, organic farmers generally exhibited very “alternative” scores on this scale, while most conventional farmers expressed views at the opposite end of the Likert scale. Yet, in a recent survey (Michelsen, 1998) among ca. 500 newly converted organic farmers, there were *no* respondents with extreme views in either end of the scale. Environmental concern was still the dominant motive for conversion, however.

¹⁴ In the MFAF’s document on *The Future Common Agricultural Policy of the EU* it is stated (p.7) that “The primary rule is that a market orientation with a lower price level gives environmental benefits”.

policy innovation at State level and policy making at federal level has been important in the development of environmental regulation in the US (Sabatier, 1993).

5.2 Job creation as a policy rationale

In many documents (e.g. The Ministry of Food, Agriculture and Fisheries, 1997b) the employment effects of agriculture and international liberalisation are mentioned. Although agricultural employment is expected to decrease, even the multilateral liberalisation scenario is not thought to be alarming:

“For the EU as a whole out-migration will be in the order of 130,000 employees per year, whereas the out-migration from the Danish farming sector is estimated at well over 1,600 employees per year, or about 20,500 for the period 1992-2005... The Danish agricultural sector is not expected to be affected to the same extent as the EU as a whole, among other things because pig production, which is barely subsidised at all under the existing agricultural policy, is so prominent in the Danish farming sector.”

(The Ministry of Food, Agriculture and Fisheries, 1997b: 79)

It deserves notice, perhaps, that Denmark does not have a rural problem comparable to that of many other countries: even in the remotest areas it is possible to commute to urban jobs by car. In documents from the Agricultural Council, the employment effects of the farming sector and its auxiliary industries are often mentioned. This is the case, for example, in its Internet presentation of the Danish food sector. In some counties about 20 per cent of all employment is within agriculture and related industries.

5.3 Concluding remarks

Very often, the main front line in environmental discussions is seen as that between environmental concerns versus commercial objectives, international competitiveness, growth and employment. Fortunately, the trade-off between these policy objectives is not a static one. A central aim of the present project is to analyse how policies stimulating innovations may shift the trade-off to achieve both environmental and wider economic objectives as indicated in the Figure below.

Environmental objectives

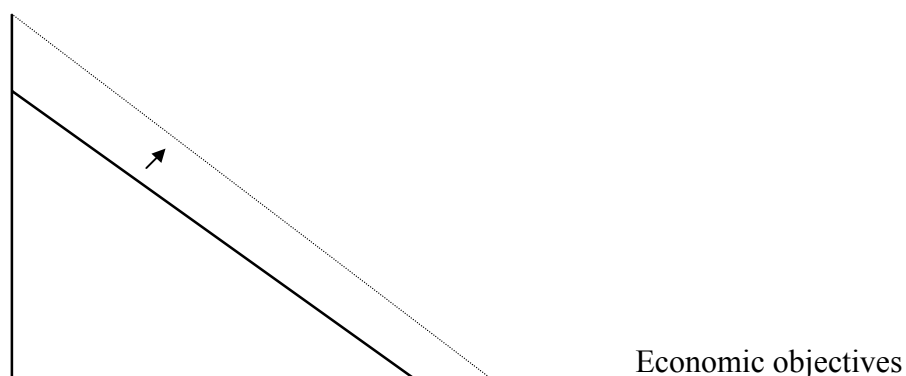


Figure 5.1 The trade-off between environmental and economic policy objectives

5.4 Hypotheses and research questions

The previous sections have set out the Danish policy framework for technical change within the biotechnology, agrochemical and - to a lesser degree - the seeds industry. This framework comprises policies on science, technology and innovation, environmental protection, public health and biodiversity, and farm support at national and European level. Obviously, the combined impact on innovation of this broad range of policies is difficult to disentangle. For present purposes we shall confine ourselves to asking some basic research questions and hypotheses to guide our future research on the PITA project.

As mentioned in the previous section, public debates on environmental regulation are often based on the implicit assumption that there is a trade-off between environmental objectives and other commercial and socio-economic objectives. This begs the question how environmental protection measures relate to international competitiveness in the short term as well as in a long-term perspective.

In the short term environmental levies and other restrictions obviously reduce the profit opportunities of those companies supplying the European market. To the extent that competing technologies render product markets of, say, the chemical industry superfluous, this may also be the long term consequence. But then, the development and marketing of environmentally lenient products may add to the long-term competitiveness of those companies, not just in European markets but in other parts of the world as well.

Based on Section 2, three types of policy may be broadly distinguished:

- policies influencing the technological input side, e.g. by supporting the development of specific technologies or types of product;
- policies designed to support or inhibit the dissemination of specific innovations; and
- policies affecting long-term market shares.

The publicly funded research programmes (BIOTEK and FØTEK) touched upon in Section 2 are obvious examples of the first types of policies. Policies of supporting agricultural advisory systems or technological information centres are examples of the second type of policies, while levies or bans on harmful chemicals, or restrictive labelling requirements, are examples of the third type.

From a regulatory perspective, it is important to know how these types of policy may influence the scope and direction of innovation within the three sectors analysed. Company interviews may shed more light on this. Also, the impact of the regulatory environment (in terms of strictness, clarity and stability) on innovation incentives is an important issue.

Within innovation theory, the concept of lead users is a central one. Lead users are users - or groups of users - whose demand is a reliable indicator of future demand in other markets. In view of the political dynamics touched upon in previous sections, it is conceivable that some national markets are seen by companies as 'lead markets', which should be followed closely. This will show up in the extent to which companies have developed specific products for specific national markets, and subsequently marketed these products in other markets. In terms of inducing firms to find more benign products and methods, there may therefore be spill-over effects from national regulatory practices.

It is conceivable that the popular unease with biotechnology will impede the development of an advancement biotechnology industry in Denmark, whereas attempts at doing so may induce consumers to resort to the organic food sector as a means of avoiding genetically manipulated foods or food ingredients. At least in the domestic market, the 'dual' science, technology and innovation policy pursued by Danish authorities may first of all benefit the expansion of the organic sector. In view of the widespread anxieties about gene technology (not just in Denmark but in many other countries as well) it seems reasonable to assume that a profitable niche for non-genetically-modified products will continue to exist for at least a number of years. In particular, if the labelling of conventional food products does not permit consumers to identify non-genetically-modified products, this may increase the demand for organic food products (provided organic farmers do not accept GMOs).

If the organic food sector continues to expand, this will create market opportunities for competing technologies (e.g. advanced mechanical cleansing systems) with possible spin-off effects on the conventional sector.

On the whole it may be expected that the combined pressures from science, technology and innovation policies to support the development of competing technologies and environmental measures to give up or reduce the use of chemicals will continue to reduce the market for pesticides in Denmark. To the extent that the basis of agricultural support at EU level is shifted towards environmental objectives, this will probably add to the pressures against the agrochemical industry.

References

- Andersen, M.S. and D. Liefferink, eds. (1997), *European Environmental Policy: The Pioneers*. Manchester University Press. Manchester and New York.
- Andersen, M.S. and M.W. Hansen (1991), *Vandmiljøplanen. Fra forhandling til symbol.*[*The Aquatic Environment Plan. From negotiation to symbol*] Harlev J. Niche.
- Bager, T. and J. Proost (1997), Voluntary Regulation and Farmers' Environmental Behaviour in Denmark and The Netherlands. *Sociologia Ruralis* Vol. 37 (1), 79-96.
- Bager, T. and V. Søgaard (1994), *Landmanden og miljøet* [*The Farmer and the Environment*]. South Jutland University Press. Esbjerg.
- Bernstein, N. (1994), 'National Support: Impact and Prospects' in R. Kjeldahl and M. Tracy (eds) *Renationalisation of the Common Agricultural Policy?* Tonbridge: Combined Book Services.
- Bjerregaard et al (1997) *Herbicide Resistant Crops and Impact of their Use. Methods for risk assessment of transgenic plants No. 1*. Environmental Project No. 346. Ministry of Environment and Energy, Danish Environmental Protection Agency, Copenhagen (Danish edition in 1994 as *Miljørapport no. 270*).
- Brown, C. (1988), *Price Policies of the CAP - Retrospect and Prospect*. Statens Jordbrugsøkonomiske Institut. København.
- Buckwell, A.E., D.R.Harvey, K.J.Thomson & K.A.Parton (1982), *The Costs of the Common Agricultural Policy*.
- Cochrane (1958), *Farm Prices: Myth and Reality*. Minnesota. University of Minnesota Press.
- Danish Directorate for Development (*Strukturdirektoratet*) (1998), *Strategi 2000 for Fødevareministeriets Rådgivende Forskningsudvalg* [*Strategy 2000 for the Food Ministry's Advisory Research Committee*]. The Ministry of Food, Agriculture and Fisheries. Copenhagen.
- Daugbjerg, C. (1996), *Policy Networks under Pressure: Policy Reform, Pollution Control and the Power of Farmers*. Department of Political Science, Aarhus University.
- Daugbjerg, C. (1997a), *Reforming the CAP: The Roles of Policy Networks and Broader Institutional Structures*. Department of Co-operative and Agricultural Research (ALF). South Jutland University Centre. ALF working paper 1997.
- Daugbjerg, C. (1997b), *Organised Interests and The Paradox of Green Taxes*, Department of Co-operative and Agricultural Research (ALF). South Jutland University Centre. ALF working paper 1997.
- Federation of Danish Industries (1996), *Brev til Folketingets Sundhedsudvalg vedr. mærkning af genmodificerede sojabønner, 27. november.* [*Letter to the Parliamentary Health Committee concerning the Labelling of Genetically-Modified Soya Beans, 27th November*].
- Folketinget's proceedings (1994), *Forespørgsel nr. F 13 til Sundhedsministeren* [*Question no, F 13 for the Minister of Health*] Folketingets forhandlinger spalte 1440-1453. 4. december.
- Forum of Industrial Development (1989). *Hvad skal fødevareindustrien i Danmark leve af?* [*What is the Danish food industry going to live on?*] Preliminary analysis. Copenhagen.
- Gen-Debat, 1988 (Gene Debate) *Patent på levende organismer* (*Patenting of living organ-*

- isms). No. 4. Ed. Jesper Toft. NOAH.
- Grant, W. (1997), *The Common Agricultural Policy*. St. Martin's Press, Inc. New York.
- Gravesen, Lene (1998), [Status on the pesticide action plan]. In DJF: 15th *Danish Plant Protection Conference*. Forthcoming.
- Grunert, K.G., A.Baadsgaard, H.H.Larsen and T.K.Madsen (1996), *Market Orientation in Food and Agriculture*. Kluwer Academic Publishers. Boston. Dordrecht. London.
- Hall, Peter (1993), "Policy Paradigms, Social Learning, and the State. The Case of Economic Policy-making in Britain", *Comparative Politics* Vol. 25 (3), 275-96.
- Harrison, G.W., T.F.Rutherford & I. Wooton (1995), 'Liberalizing Agriculture in the European Union', *Journal of Policy Modelling* 17 (3):223-255
- Højbjerg & Marker (1995), *Den danske centraladministration og EU [The Danish Central Administration and the EU]*. CORE Arbejdsrapport nr. 13. Copenhagen Research project on European Integration. Copenhagen.
- Jorgensen, R.B. and Andersen, B. (1994), 'Spontaneous hybridization between oilseed rape (*Brassica napus*) and weedy *B. campestris* (*Brassicaceae*): a risk of growing genetically modified oilseed rape', *American Journal of Botany*, 1st December, 81 (12): 1620.
- Just, F. and K. Omholt (1984), En komparativ analyse af udviklingen i og årsagerne til det ændrede samspil mellem andelsorganisationer, generelle landbrugsorganisationer og staten i Danmark og Norge i perioden ca. 1930-80. [A Comparative Analysis of the Interaction between co-operatives, agricultural organisations and the State in Denmark and Norway during 1930-80] In Juhani Laurinkari *et al.*: *Samspillet mellem Staten, Landbrugsorganisationerne og Landbrugskooperationen [The Interaction between the State, the Agricultural Organisations and the Agricultural Co-operative Movement]* South Jutland University Press 1984. Esbjerg.
- Kjellson, G. & V. Simonsen (1994), *Methods for risk assessment of transgenetic plants No.1 - Competition, establishment, and ecosystem effects*. Birkhauser Verlag. Berlin.
- Kjellson, G. *et al.* (eds, 1997) *Methods for risk assessment of transgenetic plants No. 2 - pollination, gene transfer, and population impacts*. Birkhauser Verlag. Berlin.
- Köster, U. & S. Tangermann (1990), 'The European Community' In: Sanderson, F.H. (ed.) *Agricultural Protection in the Industrialized World*. Resources for the Future. Washington, D.C.
- Madsen, K.H. *et al.* (1997). *Modelling of Herbicide Use in Genetically Modified Resistant Crops - 1, Content and Input for Models*. Environmental Project No. 346. Ministry of the Environment and Energy, EPA, Copenhagen.
- Marsden, T., J. Murdoch, P. Lowe, R. Munton and A. Flynn (1993), *Constructing the Countryside*, UCL Press, London.
- Ministry of Agriculture (1987), *Om fremme af den offentlige fødevarerforskning, herunder ernæringsforskning, og dens erhvervsmæssige anvendelse. [On the promotion of public food and nutritional research, and its commercial application]*. Strategy proposal from the Ministry of Agriculture. Copenhagen.
- Ministry of Agriculture (1991), *Handlingsplan for et bæredygtigt landbrug. [Action Plan for Sustainable Farming]*. Copenhagen.
- Ministry of Food, Agriculture and Fisheries (1996), *Betænkning fra udvalget om Natur, miljø og EU's landbrugspolitik*. Betænkning nr. 1309 [Report from the Committee on Na-

- ture, the Environment and the CAP].* Report no 1309. Copenhagen.
- Ministry of Food, Agriculture and Fisheries (1997a), *The future Common Agricultural Policy of the EU*. Available at http://www.fvm.dk/eusamarb/..eusamarb\eng_future_cap.htm.
- Ministry of Food, Agriculture and Fisheries (1997b), *De økonomiske konsekvenser af den fremtidige fælles landbrugspolitik set i lyset af EU's udvidelse. [The Economic Consequences of the future CAP and the extension of the EU]*. Copenhagen.
- Ministry of Foreign Affairs (1994), *Besvarelse vedr. EF-domstolens afgørelse i PCP-sagen. [Responce Concerning the Verdict of the European Court of Justice on the PCP case]*. Folketingets miljø- og planlægningsudvalg. Bilag nr. 401.
- MoE, Ministry of the Environment (1994), letter to UK Department of Environment on PGs oilseed rape, 10 August.
- Munk Christiansen, P. (1992), 'Industrien og miljøet. En analyse af industriens syn på miljøreguleringen i Danmark. [Industry and the Environment]. *Politica* 3 (92), 271-286.
- Munk, K.J. (1994), 'The development of agricultural policies and trade relations in response to the transformation in Central and Eastern Europe' In: the European Commission, Directorate General for Economic and Financial Affairs: *European Economy - The Economics of the Common Agricultural Policy* (5) 1994.
- Ockenden, J. and M. Franklin (1995), *European Agriculture - Making the CAP fit the future*. The Royal Institute of International Affairs. London.
- Pavitt, K. (1984) Sectoral patterns of technical change: towards a taxonomy and a theory. *Research Policy*, 13 (5), 343-73.
- PLS Consult (1997), *Dialog med Fødevarer [A Dialogue with Foods]*. The Ministry of Business and Industry.
- PLS Consult (1998), *FØTEK-indsatsens kommercielle effekter [The Commercial Effects of the FØTEK Programme]*. Forskningsrådene.
- Sabatier, P.A. (1993), 'Policy Change over a Decade or More' In P.A. Sabatier & H.C. Jenkins-Smith (eds.), *Policy Change and Learning: An Advocacy Coalition Approach*. Westview 1993.
- Sbragia, A. (1996), 'Environmental Policy: The 'Push-Pull' of Policy-Making'. In: Helen Wallace & William Wallace (eds), *Policy-making in the European Union*. Oxford University Press, Oxford.
- Schroll, H. (1997), 'Miljøreguleringens historie' ['The History of Environmental Regulation*] In *Miljøregulering - tværfaglige studier [Environmental Regulation - Interdisciplinary Studies]*. Roskilde Universitetsforlag. Roskilde.
- Søgaard, V. (1994), *Farmers, cooperatives, new food products*. MAPP. The Aarhus School of Business, Aarhus.
- Toft, J. (1987) Genteknologi truer nu vort demokrati (Genetechnology now a threat to democracy) Danish Newspaper Politiken. June 25th.
- Toft, J. (1988a) *Skal planter privatiseres og fratages deres suverænitet? (Should it be possible to privatize plants and take away their sovereignty)* Agricultural weekly magazine *Landsbladet*, August 19th.
- Toft, J. (1988b) *Respekten for de levende organismer (The respect for living organisms)*
- Toft, J. (1994), *Tjener, er der et gen i min tomatsuppe? [Waiter, is there a gene in my tomato soup?]*. Dokumentation fra Juni Bevægelsen (3) 27th October.
- Toft, J. (1996a), Denmark: seeking a broad-based consensus on gene technology. *Science and Public Policy*, Vol. 23, no. 3, June 1996: 171-174. Beech Tree Publishing, Surrey.
- Toft, J. (1996b), *Consumers' Viewpoint on Genetically Modified Products*, The Toxicology

- Forum, European meeting, 13th May.
- Toft, J. (1997) *Biopiraterne ligger på lur* Danish newspaper Information, July 7th.
- Toft, J. and J.R. Porter (1997a), *Mennesker kan ikke ejes (Humans can't be owned)* Danish Newspaper Information June 30th.
- Toft, J. and J.R. Porter (1997b), *Letter to the Danish Parliament* including a comparison between the decision in 1991 and the current Directive. November 1998.