# Dynamics in crop protection, agriculture and the food chain in Europe

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Overview on the vital role of plant protection in Europe in maintaining and enhancing the dynamics of agricultural production and the food chain. The report offers an overview of the achievements of more sustainable production methods in European agriculture, and the actions taken by the farming community in response to private market initiatives and public policies. Such actions establish new farming systems. The report offers factual information, as well as analyses to put trends in context.

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# List of abbreviations

| | |
|---|---|
| AH | Albert Heijn |
| ATO | Agrotechnological Institute |
| BEW | Bird's Eye Wall |
| CAP | Common Agricultural Policy |
| CBL | Food Retail Trade Organisation (Centraal Bureau Levensmiddelen) |
| CEEC | Central and Eastern European Countries |
| CIPC | Chlorpropham (chemical sprout inhibitor) |
| CLM | Centre for Agriculture and Environment |
| EAGGF | European Agricultural Guidance and Guarantee Fund |
| ECPA | European Crop Protection Association |
| ENFRU | English Fruit Company |
| ESU | European Size Unit |
| EU | European Union |
| EUREP | Euro-Retailer Produce Working Group |
| EUROSTAT | Statistical Office of the European Communities |
| FAO | Food and Agriculture Organisation of the United Nations |
| FARRE | Forum de l'Agriculture Raisonnée Respecteuse de l'Environment |
| FQC | Filières Qualité Carrefour |
| GAP | Good Agricultural Practice |
| GATT | General Agreement on Tariffs and Trade |
| GDP | Gross Domestic Product |
| ICM | Integrated Crop Management |
| IPC | Propham (chemical sprout inhibitor) |
| IPM | Integrated Pest Management |
| LEAF | Linking Environment and Agriculture |
| LEI | Agricultural Economics Research Institute |
| MJPG | Multi-Year Crop Protection Plan |
| MLHD | Minimal Lethal Herbicide Dosage |
| MPS | Floriculture Environmental Programme |
| SGM | Standard Gross Margin |
| TQM | Total Quality Management |
| UAA | Utilised Agricultural Area |
| UK | United Kingdom |
| URAA | Uruguay Round Agriculture Agreement |
| USA | United States of America |
| WTO | World Trade Organisation |

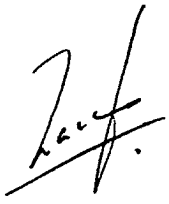
# Preface

The current report is intended to give empirical evidence of the vital role of plant protection in Europe in maintaining and enhancing the dynamics of agricultural production and the food chain. It examines the role of plant protection in agriculture and the food chain (retailers, wholesalers and food processors) and provides a comprehensive and up-to-date overview on the vital role of the plant protection industry in the food chain and agriculture in Europe. The overview of the key indicators focuses on the interaction between the provision of food and the usage of plant protection products in Europe. The report is intended to be the basis for informing government agencies (national Ministries of Agriculture and Environment, European Commission and international agencies) and other actors (e.g. industry and non-governmental agencies). Some thoughts are offered on the potential linkages between private market initiatives in achieving public policy objectives.

The work was funded by the European Crop Protection Association (ECPA). This support is gratefully acknowledged.

Several persons at LEI have contributed to this study. The following persons made important contributions. Frans Godeschalk provided data on the structure of agriculture in the EU (source: Eurostat), as well as on the expenses of plant protection products by agricultural holdings and the output they generate from crop production (source: European Commission, DG AGRI). Henk Kelholt reviewed the available information from FAO and provided information on the production of agricultural commodities. He also prepared tables on the export of crop products. This information originates from Eurostat. Mrs Myrna van Leeuwen reviewed the information on the agrifood sector, which is based on a cross-national overview of input-output tables. Finally, Bram Pronk reviewed the available information on consumption of agricultural produce, and provided of supply balance sheets for agricultural commodities (source: Eurostat). He also provided assistance in collecting material from retailers and food processors in different Member States.

The managing director,



Prof. Dr. L.C. Zachariasse

# Executive summary

*Objectives of the report*

The current report is intended to give empirical evidence to the vital role of plant protection in Europe in maintaining and enhancing the dynamics of agricultural production and the food chain. It arises from a study commissioned by the European Crop Protection Association (ECPA). The report offers an overview of the achievements of more sustainable production methods in European agriculture, and the actions taken by the farming community in response to private market initiatives and public policies. Such actions establish new and improve production and farming systems. They follow from public policies and to an increasing extent from private market initiatives. More specifically, the report has three main objectives:

- to identify key features on the dynamics of agriculture in the EU, providing evidence on the main trends in agricultural production and their interactions with the use of plant protection products;
- to examine the initiatives taken by food processors and food retailers to combine market strategies with the sustainable management of resources, and to improve the quality of food, and their impact on the use of plant protection products;
- to identify the attempts in public policies providing incentives to achieve more sustainable production methods, and the potential implications for plant protection products following from changes that might take place in such policies.

The report offers factual information, as well as analyses to put trends in context.

*Method adopted*

The report is based on desk research drawing from existing literature and data. In identifying the main trends in agricultural production we did draw on several sources of information, including FAO, EUROSTAT and the European Commission. In addition, a broad range of documents has been reviewed, among others including policy documents, trade journals, Internet pages, research reports and company brochures.

*The EU is a key producer of food*

The EU and the USA are key producers of food in the world market. For several commodities, they have a share of about a quarter of global food production (cereals, oilseeds, potatoes, sugar beets, and various types of fruit). The EU has a strong position in the world market (be-

tween brackets the share of world production) of cereals (10 per cent), potatoes (16 per cent), sugar beets (44 per cent), citrus fruit (10 per cent), primary fruit (12 per cent) and wine (60 per cent). The volume of crop production tends to increase in Europe, but the rate of increase is slowed down to less than 1 per cent during the 1980s and 1990s. This was mainly due to the reforms of the Common Agricultural Policy (CAP), among others aiming to reduce surpluses of production and to enhance the competitive position of European agriculture on the world market. By 1996, the set-aside requirements for the reception of direct payments by producers of cereals, oilseeds and protein crops has occupied about 5 per cent of total agricultural land in the EU.

*The EU is a key trader on the world market*

The export value of crop products globally amounts to about 300 billion Euro per annum. The EU is a key trader on the world market and its export to third countries has a share of 13 per cent in global trade of crop products. It follows next to the USA, which has a share of around 17 per cent.

The export of vegetables and fruit, cereals and cereal preparation, sugars, sugar preparation and honey, bulbs, cut flowers and foliage (including intra-trade) in total amounts to approximately 55 billion Euro. Export value of these products has increased by around 5 per cent per annum. More than half of it is intra-trade. About 80 per cent of the export of vegetables and fruit are intra-trade. About 40 per cent of total trade in sugar, sugar preparations and honey (which in total amounts to about 6 billion Euro per annum) is for third countries.

*The agri-food sector has a substantial share in national value added and in national employment*

Primary agriculture is no longer a major economic sector in the EU. It contributes to a limited share of GDP in most Member States, although the figure ranges from less than 2 per cent in the UK to 12 per cent in Greece. The agri-food sector (primary food production, food processing and deliveries) has a share of 6.5 per cent of total gross value added in the European Union. In addition, it has a share of almost 8 per cent of total employment in the EU. About 6.4 million persons are employed in the crop production part of the agrifood sector, with 3.6 million people in primary production. Total gross value added of the agrifood sector (crop production) is 207 billion Euro (figures for 1995).

*Specialisation and concentration of production units are dominant features of agriculture*

The EU has almost 7 million agricultural holdings, and average farm size is less than twenty hectares. Agriculture tends to move away from traditional forms of low-input, labour-intensive crop and livestock production, which have characterised most of Europe for many centuries.

Agriculture in the EU is characterised by a wide range of farming types. Two dominant trends in current farming practices prevail.

- Intensification and specialisation in regions where agriculture is most productive. The concentration of production tends to increase and agricultural holdings become more specialised. Specialised farming types currently represent about 80 per cent of the holdings and about a similar share in agricultural area. Since 1975, the number of holdings has dropped by 1.4 million, which is equivalent to a reduction of almost 20 per cent, and average farm size has increased by a third.
- Marginalisation and possibly even abandonment of agricultural land. This tends to occur in remote areas with unfavourable economic or social conditions, or on less fertile land where agriculture is unable to compete effectively with intensive production in other regions. In Spain, for example, the abandonment of agricultural land is potentially affecting 12 million hectare of land, with a major risk for erosion, loss of biodiversity and landscape deterioration.

*The use of plant protection products tends to go down with increasing output of farming*

The use of plant protection products shows wide variations across agricultural holdings in the EU, reflecting the efficiency of inputs used relative to the output achieved. This feature would indicate that changes in farming practices potentially allow improving farm output while better targeting the use of plant protection products. The group of specialist farms with highest output tend to have a less than proportional share in costs of plant protection products used. Ten per cent of the specialist horticulture holdings with highest output have a share of almost 40 per cent of crop product generated from this farming type. Similarly, this group of holdings has a share of less than 20 per cent of total expenses for plant protection products, used by this group of holdings. Efficiency indicators therefore are relevant in the identification and adoption of means to meeting environmental policy targets.

*A targeted use of plant protection products could substantially reduce the use without major losses of farm income*

A wide range of options would be available to farmers in their attempt to reduce the use of plant protection products. The costs involved may range largely as well. The adoption of a curative approach - with plant protection products to be used only where lack of treatment would cause major harvest losses - would potentially reduce the use of plant protection products by 80 per cent. Gross factor income from crop production might drop by some 20 per cent. However, a targeted use of plant protection products could almost halve the use of plant protection products without major additional costs to the farming sector neither to society. Such an option would be preferred from an economic point of view. Specific measures could then be required from farming to control the emissions of plant protection products to watercourses. In contrast, the conversion to organic production methods might be stimulated in the

longer run. A full conversion of conventional farming to organic production would be too costly at least in the short run, also having larger demands for labour and substantial costs to society, requiring among others the import of more feed products.

*Consumer concerns change demand for food*

European consumers demand higher quality products, more convenience products and more variety in food products. In addition, they are increasingly concerned about issues like food safety, environmental sustainability and ethically appropriate methods of production. Food processors and food retailers have responded in two ways. First, they have set up quality control systems for the whole supply chain. Second, they have developed special cultivation requirements for supplying farmers. For instance, farmers supplying the retailers participating in the EUREP working group on fresh produce will have to apply the EUREP Good Agricultural Practices (GAP). These practices are based on the ideas and experiences of Integrated Pest Management (IPM) and Integrated Crop Management (ICM). This EUREP Protocol offers a harmonisation of private quality requirements for fresh produce throughout Europe.

*Concentration, internationalisation and vertical co-ordination in the food chain*

Major structural changes are taking place in the European agrifood sector. Processes of concentration and internationalisation have given food retailers substantial market power vis-à-vis their suppliers. This in turn has triggered a process of consolidation among food processors, wholesalers and even farmers. All firms participating in a production and distribution chain for agricultural and food products - farmers, processors, wholesalers and retailers - are increasingly working together to gain efficiencies in logistics and information exchange and to set up quality monitoring and control systems throughout the chain. One of the results of concentration and internationalisation processes among food retailers is that domestic quality requirements that have been developed by the large retailers will also be applied in other countries. Thus, the expansion of supermarket firms from the UK, the Netherlands and France into Southern and Eastern Europe will expand the geographical area where strict quality requirements for fresh produce apply. While large German retailers follow a different strategy, with more emphasis on competition at low prices, they do not seem to have much influence on the dominant European retail strategy on fresh and chilled produce.

*Impact on the use of plant protection products*

Structural changes and shifting strategies in the food processing and food retail industries have effect on the use of plant protection products in cultivation and post-harvest activities. First, as private label products are strategically important for retailers, these companies will dictate quality requirements for the whole supply chain and will develop guidelines for minimal use of plant protection products by supplying farmers. Second, consumer demand for year-round

availability of fresh produce on the one hand and concentration and internationalisation of retailers on the other hand lead to world-wide sourcing of food products. As a result, farmers will apply similar cultivation guidelines (including restrictions on the use of plant protection products) across different countries. Third, ICM programmes are becoming increasingly important, all over Europe. Both growers and purchasers have set up ICM programmes, in which the use of plant protection products is a major element. Fourth, as part of their differentiation strategy retailers and food processors are actively involved in product innovation. New products do allow for better control regarding their impact on the environment. Thus, the development of new food products will lead to more constraints for on-farm use of plant protection products.

*Agricultural policy increasingly acknowledges its role in the management of the rural countryside*

Agricultural policy is gradually transformed by reducing market and price support measures into direct payments. The Agenda 2000 reform decided upon in 1999 includes a Rural Development Regulation, which is aimed, among others, to support a viable and sustainable agriculture and forestry sector as part of the rural economy. The European model of agriculture puts emphasis on the multi-functional nature of European agriculture, which aims to maintain the viability of the producers of food and of rural amenities. European agriculture shows different trends, including production systems that continue to intensify and focus on the supply of food, and production systems that allow for more extensive production systems. The first group of farmers increasingly responds to world market conditions and meet environmental constraints. In contrast to that, the second group of farmers continues to deliver non-marketable services for which they are remunerated by society.

*IPM might be used as a tool to establish a Code of GAP*

A Code of Good Agricultural Practice can be used as a benchmark for the conditions a farmer needs to comply with in order to be qualified for compensatory payments. Farmers meeting conditions beyond such GAP would be eligible for compensation on the costs involved of doing so. Similarly, a Code of Good Agricultural Practice might be used as a condition for direct payments under the CAP. The adoption of ICM/IPM as a basis for a Code of GAP would also allow harmonising the requirements for GAP and limit the number of controls of plant protection products.

*Role of plant protection industry will be vital in their effort to responding to societal demands*

Plant protection industry plays a vital role in the supply of new products, which supply food for the global market, and allow for a more targeted use of plant protection products, while also meeting environmental requirements and being safe for human and animal health. The

sector has experienced an active phase of mergers and increasing internationalisation. Industry will provide safer, environmentally-friendly plant protection products which are more targeted and applied in lower dosages. These responses result from the demands by the agrifood chain and consumer preferences.

# 1. Introduction

The achievement of more sustainable production systems in agriculture has gained major public momentum in European society during the past decade. Actions have been taken by the farming community to establish new and improved production and farming systems. These actions followed from public policies and, to an increasing extent, from private market initiatives as well. Private food market initiatives by retailers, food industry and farmers' organisations increasingly provide incentives to farmers to alter conventional farming systems and adopt new and improved production systems. Such market initiatives commonly combine marketing strategies with the sustainable management of resources. The adoption of new approaches in using plant protection products play an important role in the achievement of farming practices for environmental protection.

The application of uniform standards to authorise and register plant protection products has been a major step to curb pollution in European waters. Major effort is taken to restrict the use of active substances that are considered to cause harmful effects to human and animal health or to the physical and natural environment. Measures are taken to control water quality problems and connected issues, including pesticide drift, affecting air quality and biodiversity, and potential human health problems arising from pesticide use and residues in food.

The report focuses on Europe, including key facts and figures regarding agriculture, food chains and the economic and societal importance of plant protection. Specific features of European agriculture are presented by comparison with other regions in the world. The report has three main parts. First, we will provide a review of agricultural production, in terms of the supply of food and their role in international trade. Main trends in agricultural production are provided in chapter 2, in terms of production, trade and structure of agricultural holdings. The interactions of agricultural production with the use of plant protection products are examined, as well as the key economic features on the production and trade of plant protection products. Second, we will examine the European food chain in light of the protection of crops. We will review initiatives taken by the food chain in promoting farming methods that improve the quality of food and the sustainable management of resources. Their implications for agriculture to protect crops will be examined (chapter 3 of the report). Finally, we will identify key trends in European policy, both in the context of the Common Agricultural Policy (CAP) and public policies at national level, that provide incentives to achieve more sustainable production methods in European agriculture. Emphasis is given to the potential implications for plant protection following from changes that might take place in public policies (chapter 4 of the report). Conclusions of the investigation are presented in chapter 5.

The report was compiled mainly by means of a review of existing literature and data. It draws on several sources of information, including FAO, EUROSTAT and the European

Commission. A drawback of such data sources is the delay of several years in offering information for all Member States. Where available, the existing information is combined with some statements on most recent trends. In writing this report a broad range of published information has been used, including general newspapers, trade journals, Internet pages, research reports, company brochures, etc.

# 2. Agricultural production, the supply of food and international trade

In this chapter, we will provide main trends on agricultural production in the EU, as well as on the structure of farming and the supply of food, both at regional, national, EU and global level. We will also establish linkages with the use of plant protection products, and examine their role to support the dynamics in European agriculture. Section 2.1 is on agricultural production, both domestically and globally. Some key patterns of trade are presented in section 2.2. Main features on the structure of European agriculture are presented in section 2.3. Section 2.4 examines the use of plant protection products with the output achieved from farming. Some trends on the use of plant protection products are presented in section 2.5, to be followed by a note on the economic importance of plant protection industry in Europe (section 2.6).

## 2.1 Agricultural production

Global food production has more than doubled during the past three decades, and the increase of agricultural production exceeded the growth of the global population. The increase of food production was highest in Asia and South-America. The increase of agricultural production in Africa (3.5 per cent per annum since the 1960s) was below that of the population growth (4.5 per cent per annum since the 1960s) and the several wars and natural disasters caused periods of severe shortages of food. Safeguarding the provision of sufficient food in the various regions of the world therefore is an issue of societal importance. High-quality plant protection products are vital to protect crops against diseases, pests and weeds; they subsequently contributed to reduce harvest losses. The intensification of agricultural production in the main production regions of the world allowed increasing yields as well as meeting the increasing competition for land by urban development, physical infrastructure and forestry. This process of intensification is mainly observed in the production areas that are close to urban settlements; the demand for land used agriculturally typically competes with other users, which again increased land prices and gave incentives to further intensification of production.

The rate of increase of agricultural production in the EU was around 2.5 per cent per annum during the 1960s and 1970s, which again slowed down to less than 1 per cent during the 1980s and 1990s (Silvis and Van Bruchem, 2000). This turning point was mainly due to the development of the Common Agricultural Policy (CAP). Since the late 1980s, the CAP was to restore market balance and reduce surpluses of production. The increase of population in Western Europe during the past decades was around 0.5 per cent per annum.

The value of total agricultural production in the EU amounts to around 220 billion Euro. It is composed of a wide diversity of crops and livestock products, as outlined below. Euro-

pean agriculture also has a broad heterogeneity of production systems with wide-ranging geographical features. Primary agriculture is no longer a major economic sector in the European Union (EU). It contributes to a limited share of Gross Domestic Product (GDP) in most Member States, although the figures range from less than 2 per cent in the UK to 12 per cent in Greece. However, in most Member States food and agricultural products have a rather high share in total exports. Food and agricultural products have a share of about a quarter in total exports of Denmark and the Netherlands. In contrast, the share of agriculture in the GDP only is just over 2 per cent in Denmark (Lowe et al., 2000).

Although agriculture only has a limited share in national GDP, it is a dominant user of land in most European countries. Around 40 per cent of the total land area in the EU are used for agricultural production.

Similar trends on the marginal share of primary production in the national economy are observed in developed agriculture in other parts of the world. Agriculture in the USA, for example, contributes about 2.6 per cent of GDP, and 25 per cent of agricultural production was exported in 1997. Cash receipts from crop production amount to USD 109 billion, which is about half of total cash receipts from farming and ranching. Here, intensification of agricultural production also contributed to a substantial increase in agricultural output. Use of plant protection products costs about USD 8 billion, where herbicides have a share of about two-thirds of the total and insecticides account for about 20 per cent.

- *Production of agricultural commodities*

The EU and the USA are both key producers of food in the world market. In total, they typically have a share of about a quarter of global supply of agricultural produce. Table 2.1 shows the relative share of EU-agriculture in global production on a commodity basis. The EU has a share of more than 10 per cent in global production of potatoes, sugar beet, citrus fruit and primary fruit. Fruit and vegetables are concentrated in the Mediterranean part of Europe. The main production areas for citrus fruit are Spain, Italy and Greece.

The EU has a high share in global production of wine. The EU accounts for about 60 per cent of world production of wine, and reached an annual production level of 158 million hectolitre during the period 1993-1997. Also, it is the leading importer and exporter of wine, which accounts for about 80 per cent of global exports. Italy, France and Spain are the three world's largest exporters of wine. More recently, there has been a growth in export from countries like Chile, South Africa, USA and Australia, and Europe currently accounts for about three quarters of world imports of wine (Rosell and Viladomiu, 2000).

*Table 2.1 Share of world production, by commodity (%)*

| Product | EU-15 | USA | Canada | Most important producers in the EU (share of global production) |
|---|---|---|---|---|
| Cereals, total | 9.7 | 16.3 | 2.5 | France and Germany (more than 5%) |
| Oilcrops primary a) | 7.8 | 15.4 | 3.8 | France and Germany (almost 4%) |
| Potatoes | 16.7 | 7.6 | 1.5 | Germany and The Netherlands (almost 6%) |
| Sugar beets | 44.2 | 11.7 | 0.4 | France and Germany (more than 22%) |
| Citrus fruit | 10.2 | 13.3 | - | Spain and Italy (more than 8%) |
| Primary fruit b) | 11.6 | 6.2 | - | Italy and Spain (almost 7%) |
| Vegetables and melons | 8.7 | 5.5 | 0.3 | Italy and Spain (more than 4%) |

a) Includes, among others, soybeans, olives, sunflower seed, rapeseed and other seed; b) Includes, among others, apples, pears and strawberries
Source: FAO.

The volume of crop production in the EU tends to increase during the second half of the 1990s (table 2.2), while the increase in crop production is larger than in livestock production. In contrast to the production volume, production value shows a declining trend. Volume of crop production increased by approximately 10 per cent during the 1990s, but the reduction of prices caused the value of crop production to decline by about 20 per cent (Silvis and Van Bruchem, 2000). Production volume of cereals responded to the set-aside requirements, and about 5 per cent of agricultural land were set aside during the mid-1990s to allow farmers being eligible for compensatory payments. The rate of land that is set aside shows a wide variation across Member States. Less than 2 per cent of agricultural land is set aside in countries with small farm size structures (e.g. Belgium, Greece, Ireland, the Netherlands and Portugal). In contrast, the share is almost 10 per cent in Denmark, Germany, Finland and Sweden (Winter, 2000).

*Table 2.2 Agricultural production by commodity in the EU, 1990, 1995 and 1999 (in million tons)*

| Commodity | 1990 | 1995 | 1999 |
|---|---|---|---|
| Cereals, total | 188.3 | 180.0 | 202.1 |
| Oilcrops primary a) | 6.0 | 6.3 | 8.1 |
| Potatoes | 49.5 | 46.0 | 48.1 |
| Sugar beets | 118.8 | 111.9 | 114.8 |
| Citrus fruit | 9.1 | 8.9 | 9.5 |
| Primary fruit b) | 61.1 | 56.2 | 58.1 |
| Vegetables and melons | 52.4 | 51.6 | 53.9 |

a) Includes, among others, soybeans, olives, sunflower seed, rapeseed and other seed; b) Includes, among others, apples, pears and strawberries
Source: FAO.

- *The agrifood sector*

The agrifood sector includes primary agricultural production, processing and deliveries to these sectors, and includes crops and livestock products. In total it has a share of 6.5 per cent of total gross value added in the EU-15 (table 2.3). It is less than 5 per cent in Austria, Germany and Sweden, and exceeds 10 per cent in Denmark, Greece, Ireland and Portugal. The share of the agrifood sector in national employment exceeds that of its share in gross value added. This feature of the agrifood sector typically results from the labour intensive production methods applied in primary production relative to its share in gross value added. The only exception is Denmark and the UK. The agrifood sector has a share of 10 per cent in total national value of Denmark, while its share in national employment is slightly below 8 per cent.

*Table 2.3 Shares of gross value added and employment of the agrifood sector in national total in EU-15 (%) (1995)*

| Country | Share of agrifood sector in national value added | Share of agrifood sector in national employment |
|---|---|---|
| Austria | 4.9 | 7.4 |
| Belgium-Luxembourg | 5.4 | 6.0 |
| Denmark | 10.0 | 7.8 |
| Finland | 7.6 | 9.8 |
| France | 7.7 | 8.4 |
| Germany | 4.6 | 6.2 |
| Greece | 12.3 | 16.8 |
| Ireland | 14.5 | 17.5 |
| Italy | 6.4 | 7.2 |
| Netherlands | 8.3 | 8.9 |
| Portugal | 11.5 | 14.0 |
| Spain | 8.7 | 10.2 |
| Sweden | 3.9 | 4.5 |
| United Kingdom | 6.4 | 5.2 |
| EU15 | 6.5 | 7.7 |

Source: LEI.

*Crop production in the agrifood sector*

Primary crop production mainly includes arable crops and horticultural crops. The relative shares of primary crop production, processing and deliveries in total gross value added and employment of EU 15 are presented in figure 2.1 and figure 2.2. The three components of the agrifood sector (primary production, food processing and deliveries) each have a share of

around 30-35 per cent of total gross value added (figure 2.1). Primary production has a share of about a third of gross value added in the European Union, and it has a share of more than half of total employment. The figure reflects the high level of employment in primary production relative to the other parts of the agribusiness sector. Gross value added per employee in processing and deliveries exceeds that of primary production. It is highest in deliveries (almost 50,000 ECU per employee). The agricultural gross value added per employee (20,000 ECU per employee) is about 60 per cent below that of deliveries.

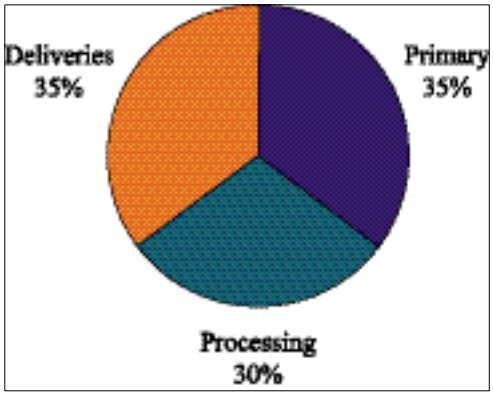



*Figure 2.1* *Gross value added of the agrifood sector in the EU (crop production)*

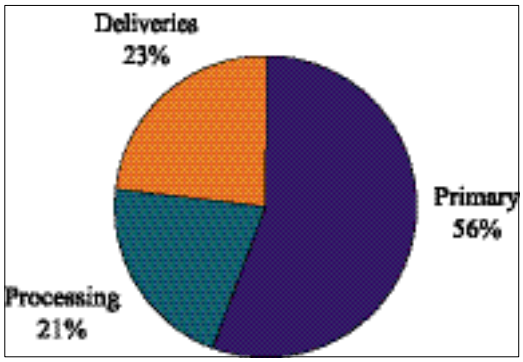



*Figure 2.2* *Employment of the agrifood sector in the EU (crop production)*

Total gross value added of the crop food sector in 1995 amounted to 206 billion ECU (table 2.4). About a third is for primary production, as presented in figure 2.1. Similar shares are also observed at EU-level for food processing and deliveries to the agrifood sector. France and Germany each account for 20 per cent of the total of the EU, to be followed by Italy (15 per cent) and the UK (12 per cent). France, Germany and Italy account for 56 per cent of total gross value added of the agrifood sector in the EU. With the exception of Denmark, Finland, Ireland and Sweden, crop production has a share of more than half of total gross value added in the agrifood sector in the Member States. It exceeds 60 per cent in Italy (62 per cent) and Greece (73 per cent).

The UK has a small share of primary production in total employment in the agrifood sector. This is mainly due to the employment in business and finances that is related in an indirect manner to the agrifood sector. Almost 6.4 million persons are employed in crop production (table 2.5). Primary production has a more than proportional share of employment in the agrifood sector.

*Table 2.4 Gross value added (million ECU) of agrifood sector (crop production) by category and Member State in 1995*

| Country | Primary | Processing | Deliveries | Total | Share of crop production in total agrifood sector (%) | National share of crop prod. in EU total (%) |
|---|---|---|---|---|---|---|
| Austria | 821 | 1,527 | 1,306 | 3,654 | 50.2 | 1.8 |
| Belgium-Luxembourg | 1,235 | 2,719 | 2,374 | 6,328 | 55.7 | 3.1 |
| Denmark | 2,007 | 1,248 | 2,215 | 5,470 | 46.9 | 2.7 |
| Finland | 1,215 | 897 | 839 | 2,951 | 44.3 | 1.4 |
| France | 16,202 | 11,199 | 15,234 | 42,635 | 53.5 | 20.7 |
| Germany | 6,901 | 15,106 | 20,953 | 42,960 | 54.8 | 20.8 |
| Greece | 5,557 | 471 | 350 | 6,378 | 73.3 | 3.1 |
| Ireland | 521 | 819 | 481 | 1,821 | 28.8 | 0.9 |
| Italy | 16,729 | 6,874 | 6,913 | 30,516 | 62.1 | 14.8 |
| Netherlands | 4,890 | 2,996 | 4,169 | 12,055 | 53.7 | 5.8 |
| Portugal | 1,635 | 1,601 | 794 | 4,030 | 54.3 | 2.0 |
| Spain | 8,964 | 4,944 | 4,985 | 18,893 | 59.2 | 9.2 |
| Sweden | 657 | 860 | 1,408 | 2,925 | 46.4 | 1.4 |
| United Kingdom | 5,561 | 10,047 | 10,167 | 25,775 | 54.9 | 12.5 |
| EU15 | 72,895 | 61,308 | 72,188 | 206,391 | 55.1 | 100.0 |

Source: LEI.

Table 2.4 shows the rather even distribution of total gross value in the EU across primary production and deliveries (both of them having a share of 35 per cent of the agrifood sector in the EU) and processing (with a share of 30 per cent of the agrifood sector in the EU). If measured in employment, primary production includes about 55 per cent of total employment of the agrifood sector. However, in the UK, only a quarter of total employment in agrifood sector is employed in primary production. Here, almost half of the employment in the agrifood sector is related to deliveries.

*Table 2.5 Employment (1,000 persons) of agrifood sector (crop production) by category and Member State in 1995*

| Country | Primary | Processing | Deliveries | Total | Share of crop production in total agrifood sector (%) | National share of crop prod. in EU total (%) |
|---|---|---|---|---|---|---|
| Austria | 52 | 42 | 22 | 116 | 45.8 | 1.8 |
| Belgium-Luxembourg | 69 | 49 | 31 | 149 | 65.6 | 2.3 |
| Denmark | 36 | 29 | 28 | 93 | 47.7 | 1.5 |
| Finland | 53 | 18 | 11 | 82 | 42.9 | 1.3 |
| France | 566 | 210 | 290 | 1,066 | 56.7 | 16.8 |
| Germany | 358 | 301 | 304 | 963 | 54.3 | 15.2 |
| Greece | 442 | 35 | 8 | 485 | 65.1 | 7.6 |
| Ireland | 28 | 13 | 8 | 49 | 22.3 | 0.8 |
| Italy | 719 | 147 | 144 | 1,010 | 63.6 | 15.9 |
| Netherlands | 135 | 58 | 71 | 264 | 55.2 | 4.2 |
| Portugal | 302 | 48 | 31 | 381 | 61.7 | 6.0 |
| Spain | 573 | 138 | 148 | 859 | 65.9 | 13.5 |
| Sweden | 36 | 27 | 20 | 83 | 45.1 | 1.3 |
| United Kingdom | 188 | 221 | 346 | 755 | 56.1 | 11.9 |
| EU15 | 3,557 | 1,336 | 1,462 | 6,355 | 57.8 | 100.0 |

Source: LEI.

## 2.2 Patterns of trade on the global market

The creation of the European Community has implied a steady growth of an accessible and stable internal market. The increasing competition within a market that grew with the enlargement of the current European Union gave rise to regional specialisation and increased production in areas with comparative advantages. The production could increase within the EU because of the free internal trade and the common market. Export of crop products (including vegetables and fruit, cereals and cereals products and sugar products, bulbs and cutflowers) has increased since the late 1980s from almost 33 billion ECU per annum to more than 55 billion ECU (late 1990s). Total export value of the commodities (including intra-trade) increased by two-thirds during a period of ten years. The export of vegetables and fruit almost doubled during this period from 14 billion ECU (1988) to well over 27 billion ECU (1998) (table 2.6). Production and trade increased at highest rates with horticultural products, including vegetables and fruit, bulbs, cut flowers and foliage. These commodities are under a light market regime, without price support measures but instruments apply on market intervention and border measures.

*Table 2.6 Export of crop products from the European Union by commodity groups (million ECU), including intra EU-trade*

| Commodity group | 1988 | 1990 | 1995 | 1998 |
|---|---|---|---|---|
| Vegetables and fruit | 14,434 | 17,409 | 25,096 | 27,603 |
| Cereals and cereal preparation | 11,260 | 13,610 | 15,852 | 16,436 |
| Sugars, sugar preparations and honey | 3,627 | 4,208 | 5,841 | 6,087 |
| Bulbs, tubers etc. | 1,945 | 2,307 | 2,768 | 2,755 |
| Cut flowers and foliage | 1,578 | 1,864 | 2,289 | 2,297 |
| Total | 32,844 | 39,398 | 51,846 | 55,178 |

Source: Eurostat.

The export of crop products from the EU is mainly intra-trade. This applies to vegetables and fruit (figure 2.3) (about 80 per cent is intra-trade), cereals and cereal preparations (figure 2.4) (about three-quarters is intra-trade) and sugars, sugar preparations and honey (figure 2.5) (about 60 per cent is intra-trade).

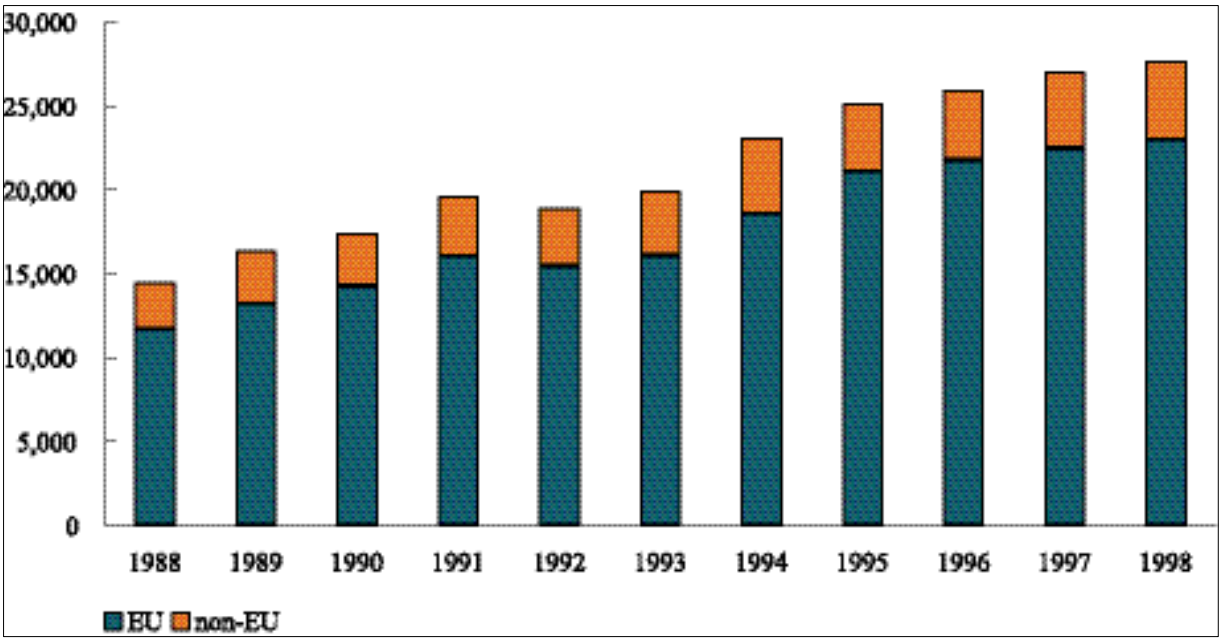



*Figure 2.3 EU exports of vegetables and fruit by destination in mln. ECU*

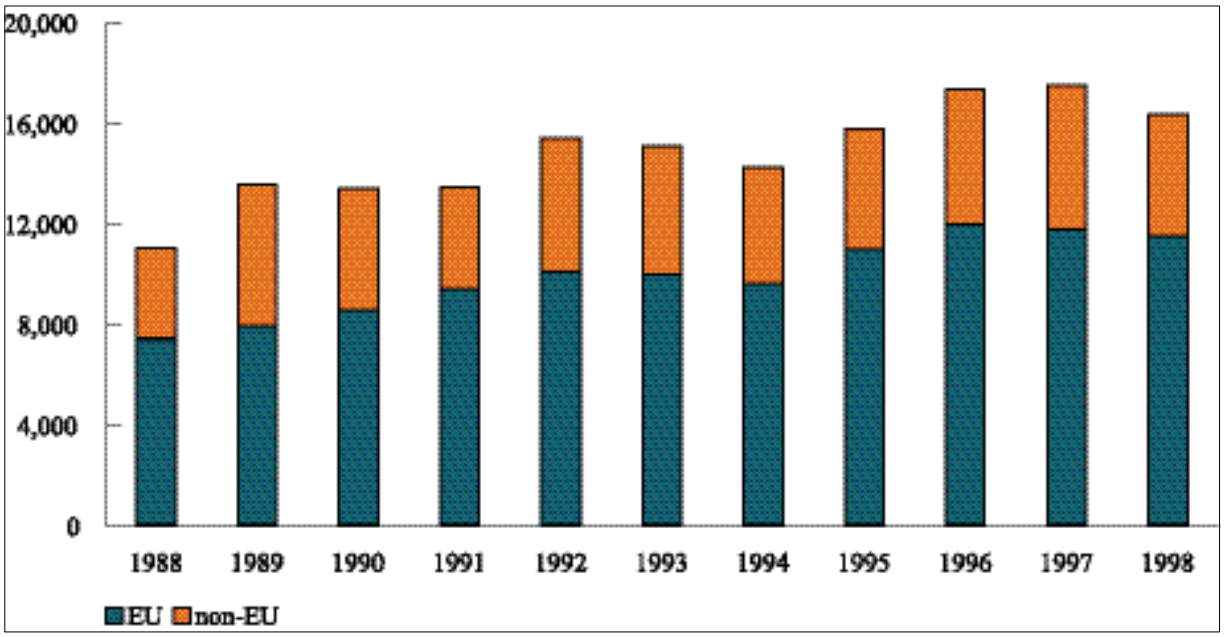



*Figure 2.4 EU exports of cereals and cereal preparations by destination in mln. ECU*

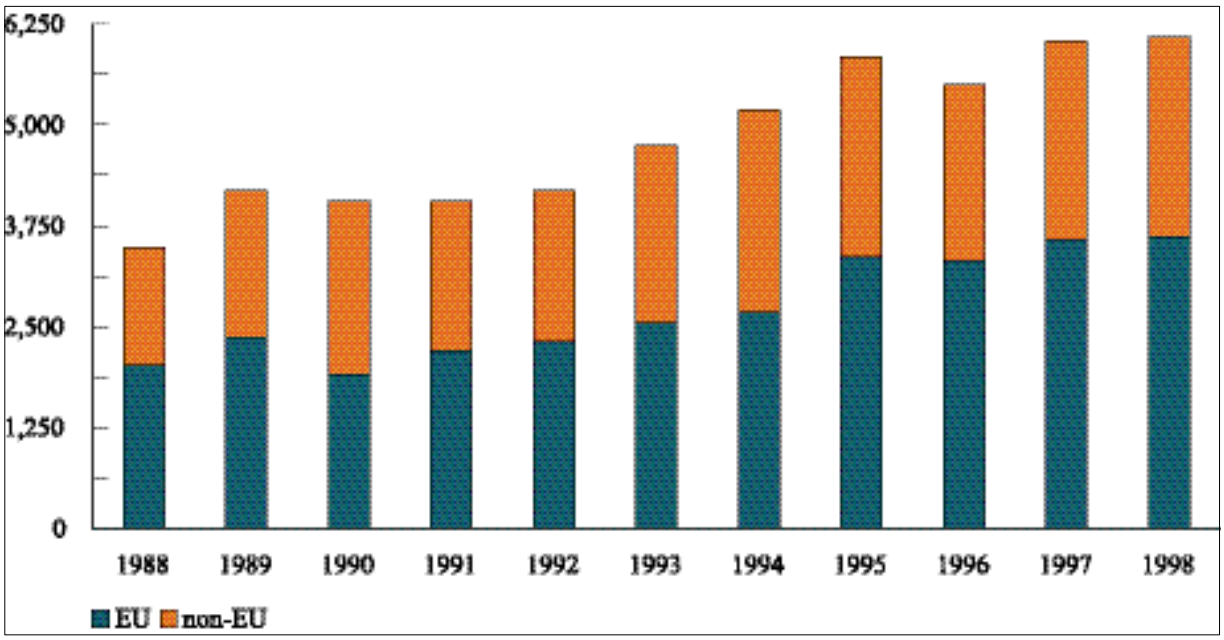



*Figure 2.5 EU exports of sugars, sugar preparations and honey by destination in mln. ECU*

## 2.3 Structure of farming

Two dominant trends in current farming practices are intensification, concentration and specialisation in some areas, and marginalisation and abandonment in others (European Commission and Eurostat, 1999). They both involve a move away from traditional forms of low-input, labour-intensive crop and livestock production, which have characterised most of Europe for many centuries.

- First, *intensification and specialisation* involves the development of capital-intensive and geographically specialised farming, which is mainly observed in regions where agriculture is most productive. Competitive advantages may arise in some regions because of better biophysical conditions, more rationalised farm structures, the integration of primary production with food processing industries and well developed farm extension services. Intensification reduced crop rotation and plant protection products were applied to reduce the risks of the occurrence of pests and diseases.
- Second, *marginalisation and large-scale abandonment* of agricultural land tends to occur in remote areas with unfavourable economic or social conditions, or on less fertile land where traditional extensive agriculture is threatened by its inability to compete effectively with intensive production in other regions. Abandonment, degradation and economic decline currently threaten the extreme north and south of Europe, where harsh natural conditions, poor soils and long distances to markets increase the costs of agricultural production and rural populations are falling. In the southern part of Europe, marginalisation and abandonment are significant problems across much of the interior of southern France, the Iberian Peninsula and Greece, and in many parts of Italy. In Spain, for example, the abandonment of marginal land with low productivity is potentially affecting about 12 million ha of land, with a major impact for soil erosion, fires, loss of biodiversity and landscape deterioration in general (Varela-Ortega and Sumpsi, 1998).

Agriculture in the EU is characterised by a wide range of farming types. By 1997, the EU has almost 7 million agricultural holdings, and farm size in the EU on average is around 18 hectares (table 2.7). The number of agricultural holdings shows a declining trend, with increasing specialisation of production and more intensive farming practices applied. The number of agricultural holdings has dropped between 1975 and 1995 by more than 1.4 million holdings, which is equivalent to a reduction of almost 20 per cent. More than 40 per cent of the number of holdings disappeared during this period in Belgium, Luxembourg, Denmark and France. With the reduction of the number of holdings they also used more agricultural land. Farm size has increased from 15 to 18 ha during the period between 1975 and 1995, which was an increase of about 20 per cent.

*Table 2.7 Structure of agricultural holdings in the EU in 1997, classified according to ESU*

| Country | Holdings < 4 ESU | | Holdings 4 - 40 ESU | | Holdings > = 40 ESU | | Total holdings | |
|---|---|---|---|---|---|---|---|---|
| | Number (% of total) | UAA/ holding (ha) | Number (% of total) | UAA/ holding (ha) | Number (% of total) | UAA/ holding (ha) | Number (1,000) | UAA/ holding (ha) |
| Belgium | 17 | 2.0 | 40 | 11.7 | 43 | 36.4 | 67.2 | 20.6 |
| Denmark | 6 | 6.0 | 54 | 19.6 | 40 | 78.2 | 63.2 | 42.6 |
| Germany | 31 | 3.5 | 46 | 18.1 | 23 | 99.1 | 536.1 | 32.1 |
| Greece | 56 | 1.6 | 44 | 7.3 | 1 | 30.7 | 821.4 | 4.3 |
| Spain | 55 | 6.7 | 40 | 23.5 | 5 | 166.8 | 1,208.3 | 21.2 |
| France | 26 | 3.7 | 44 | 30.7 | 30 | 90.3 | 679.9 | 41.7 |
| Ireland | 26 | 10.4 | 61 | 28.2 | 13 | 72.8 | 147.8 | 29.4 |
| Italy | 66 | 1.8 | 31 | 10.3 | 3 | 60.2 | 2,315.2 | 6.4 |
| Luxembourg | 20 | 4.4 | 40 | 26.5 | 40 | 76.4 | 3.0 | 42.3 |
| Netherlands | 1 | 2.4 | 38 | 7.4 | 61 | 26.0 | 107.9 | 18.6 |
| Austria | 42 | 10.9 | 53 | 17.4 | 5 | 48.3 | 210.1 | 16.3 |
| Portugal | 67 | 2.5 | 31 | 12.8 | 2 | 156.7 | 416.7 | 9.2 |
| Finland | 20 | 7.8 | 61 | 22.2 | 19 | 45.7 | 91.4 | 23.7 |
| Sweden | 37 | 7.6 | 45 | 31.6 | 18 | 97.0 | 89.6 | 34.7 |
| United Kingdom | 30 | 18.4 | 39 | 46.2 | 31 | 149.1 | 233.1 | 69.4 |
| EU-15 | 51 | 3.6 | 39 | 18.1 | 11 | 90.5 | 6,990.8 | 18.4 |

Source: Eurostat (Eurofarm), Luxembourg; adaptation LEI.

Farm size, however, differs markedly between Member States, and on average ranges between 4 ha (Greece) and 69 ha (United Kingdom). It is smallest in Greece, Italy and Portugal. In these countries, around 70 per cent of the agricultural holdings are smaller than 5 hectare. In contrast, about a third of the holdings are larger than 50 ha in the UK. Table 2.7 also masks huge differences in farm structure. More than half of EU holdings is less than four hectares in size. Thus, farming remains predominantly a small-scale operation for these holdings; which in total occupy only about 10 per cent of farmland in the EU. By contrast, the largest 10 per cent of holdings occupy more than half of the land. About half of the holdings are less than four ESU, or equivalent to less than 5,000 ECU of standard gross margin. Standard Gross Margins (SGM) exceed ECU 50,000 on around 10 per cent of the agricultural holdings (see also appendix 1 for an explanation on the classification of agricultural holdings in the European Community).

A 1999 report by the DG Agriculture, DG Environment and Eurostat (Statistical Office of the European Communities) indicate several trends of farming practices and crop produc-

tion during the past few decades (http://europa.eu.int/comm/dg06/envir/report/en/index.htm) (European Commission and EUROSTAT, 1999):

- Continued specialisation and more intensive practices. Concentration of production tends to increase and agricultural holdings become more specialised. Market support measures for some products (cereals, sugarbeet), however, have limited the concentration of regional production during the past few decades (Strijker, 1999). The development and adoption of new technologies are factors of major importance to the spatial location of production. Specialised farm types do represent about 80 per cent of the holdings and almost a similar share in utilised agricultural area (78 per cent). The use of certified seed, agrochemicals and other inputs become vital in the attempt to guarantee maximum income and achieving yields which optimise costs and products supplied.
- Steady increase of arable crops (cereals, oils seeds and protein crops) at the expense of permanent grassland and other forage crops (pasture and secondary cereals). The implementation in 1984 of the milk quota regime, for example, induced a reduction of dairy cattle, and has given incentives to grow arable crops that are not used to feed animals.

We distinguish three farming types: (i) specialist cereals, oilseeds and protein crops, (ii) specialist horticulture, and (iii) specialist vineyards). They give evidence on the diversity of farming practices across countries. Some features of these farming types are presented in the following.

Specialist cereals, oilseeds and protein crops include almost 900,000 holdings, with average size of 30 ha (table 2.8). In France and the UK, more than a third of holdings with specialist cereals, oilseed and protein crops have more than 40 ESU, and standard gross margins (SGM) on almost half of the holdings is below ECU 5,000. Farm size in this category commonly exceeds 150 ha. In contrast, only 10 per cent of the holdings in the EU-15 in this category exceed 40 ESU. Specialist holdings growing cereals, oilseeds and protein crops on average are some 30 ha, and substantially larger than the average of all agricultural holdings. Differences in farm size across countries however are large. They are below 10 ha (Greece and Italy) and exceed 50 ha in Spain, France, Ireland and the UK. Farm size on average exceeds 40 ESU on more than half of the holdings in the UK, with average size of almost 180 ha.

Specialist horticulture includes almost 200,000 holdings, with average size of less than 4 ha (table 2.9). In contrast to specialist cereals, oilseeds and protein crops, farm size of specialist holdings growing horticulture crops is substantially below that of the average size of agricultural holdings in the EU. Specialist horticulture is characterised by a relatively high intensity of land use. In the Netherlands, for example, the economic size of almost 80 per cent of specialist horticulture holdings exceeds 40 ESU. Farm size of this group of holdings on average is only five ha. Land is used rather intensively, which is reflected by a high input of labour or capital, or both. This high intensity of farming is also reflected by high usage of agrochemicals.

*Table 2.8 Structure of specialist cereals, oilseed and protein crops (farming type 13) in the EU in 1997*

| Country | Holdings < 4 ESU | | Holdings 4 - 40 ESU | | Holdings > = 40 ESU | | Total holdings | |
|---|---|---|---|---|---|---|---|---|
| | Number (% of total) | UAA/ holding (ha) | Number (% of total) | UAA/ holding (ha) | Number (% of total) | UAA/ holding (ha) | Number (1,000) | UAA/ holding (ha) |
| Belgium | 49 | 2.3 | 46 | 13.9 | 5 | 96.3 | 1.6 | 12.3 |
| Denmark | 8 | 5.9 | 81 | 20.9 | 11 | 127.4 | 21.4 | 31.5 |
| Germany | 45 | 3.6 | 47 | 20.0 | 8 | 226.0 | 49.1 | 28.3 |
| Greece | 78 | 3.1 | 22 | 18.3 | 0 | 82.9 | 68.6 | 6.7 |
| Spain | 38 | 6.8 | 53 | 49.3 | 9 | 256.1 | 143.7 | 52.4 |
| France | 16 | 4.0 | 45 | 32.8 | 39 | 137.9 | 100.3 | 69.6 |
| Ireland | 12 | 12.3 | 61 | 32.9 | 27 | 149.8 | 2.1 | 62.0 |
| Italy | 62 | 2.2 | 35 | 13.8 | 3 | 96.0 | 375.1 | 9.1 |
| Luxembourg | 33 | 7.2 | 67 | 29.7 | 0 | | 0.2 | 22.2 |
| Netherlands | 7 | 4.0 | 77 | 10.4 | 16 | 79.7 | 0.7 | 21.3 |
| Austria | 60 | 4.6 | 37 | 24.1 | 3 | 151.2 | 24.4 | 15.8 |
| Portugal | 53 | 4.4 | 38 | 36.9 | 10 | 325.5 | 8.0 | 48.1 |
| Finland | 33 | 8.5 | 65 | 29.9 | 2 | 127.1 | 27.3 | 24.9 |
| Sweden | 26 | 9.9 | 62 | 38.5 | 12 | 182.4 | 17.1 | 48.1 |
| United Kingdom | 7 | 10.6 | 41 | 35.6 | 53 | 178.3 | 28.4 | 109.3 |
| EU-15 | 48 | 3.5 | 42 | 27.3 | 10 | 162.5 | 867.8 | 30.0 |

Source: Eurostat (Eurofarm), Luxembourg; adaptation LEI.

*Table 2.9 Structure of specialist horticulture (farming type 20) in the EU in 1997*

| Country | Holdings < 4 ESU | | Holdings 4 - 40 ESU | | Holdings > = 40 ESU | | Total holdings | |
|---|---|---|---|---|---|---|---|---|
| | Number (% of total) | UAA/ holding (ha) | Number (% of total) | UAA/ holding (ha) | Number (% of total) | UAA/ holding (ha) | Number (1,000) | UAA/ holding (ha) |
| Belgium | 7 | 0.6 | 37 | 2.2 | 56 | 4.8 | 5.2 | 3.5 |
| Denmark | 0 | | 29 | 3.8 | 71 | 9.5 | 1.2 | 7.9 |
| Germany | 6 | 0.4 | 53 | 0.8 | 41 | 6.0 | 12.2 | 2.9 |
| Greece | 27 | 0.4 | 70 | 2.3 | 2 | 7.6 | 16.6 | 1.9 |
| Spain | 32 | 1.4 | 60 | 2.7 | 8 | 24.3 | 52.3 | 4.0 |
| France | 7 | 0.8 | 48 | 2.6 | 45 | 12.9 | 18.2 | 7.1 |
| Ireland | 50 | 4.0 | 21 | 23.7 | 29 | 31.5 | 0.1 | 16.1 |
| Italy | 8 | 0.4 | 62 | 1.2 | 30 | 3.8 | 46.0 | 2.0 |
| Luxembourg | 0 | | 100 | 1.0 | 0 | | 0.0 | 1.0 |
| Netherlands | 0 | 0.8 | 22 | 2.0 | 78 | 5.0 | 14.7 | 4.3 |
| Austria | 3 | 0.6 | 58 | 3.4 | 39 | 5.2 | 1.7 | 4.0 |
| Portugal | 39 | 0.6 | 55 | 2.2 | 6 | 10.4 | 11.9 | 2.1 |
| Finland | 10 | 1.6 | 64 | 5.9 | 27 | 17.2 | 4.0 | 8.5 |
| Sweden | 0 | | 48 | 1.1 | 52 | 2.7 | 1.1 | 2.0 |
| United Kingdom | 12 | 4.0 | 52 | 3.5 | 36 | 12.8 | 4.9 | 6.9 |
| EU-15 | 17 | 1.1 | 56 | 2.2 | 27 | 8.3 | 190.1 | 3.6 |

Source: Eurostat (Eurofarm), Luxembourg; adaptation LEI.

Specialist vineyards includes more than 450,000 holdings in the EU, with on average around 5 ha per holding (table 2.10). Specialist vineyards on average are slightly bigger than specialist horticulture. However, more than half of them are only slightly bigger than 1 ha, and almost 10 per cent of this group of holdings are almost 30 ha. France and Italy both have a share of about a third of total wine production in the European Union.

*Table 2.10 Structure of specialist vineyards (farming type 31) in the EU in 1997*

| Country | Holdings < 4 ESU | | Holdings 4 - 40 ESU | | Holdings > = 40 ESU | | Total holdings | |
|---|---|---|---|---|---|---|---|---|
| | Number (% of total) | UAA/ holding (ha) | Number (% of total) | UAA/ holding (ha) | Number (% of total) | UAA/ holding (ha) | Number (1,000) | UAA/ holding (ha) |
| Belgium | | | | | | | 0.0 | |
| Denmark | | | | | | | 0.0 | |
| Germany | 31 | 0.6 | 55 | 3.0 | 13 | 17.4 | 27.8 | 4.2 |
| Greece | 54 | 0.7 | 46 | 3.9 | 0 | 24.0 | 26.6 | 2.2 |
| Spain | 62 | 3.6 | 36 | 17.7 | 1 | 102.4 | 59.3 | 10.0 |
| France | 25 | 0.8 | 43 | 7.6 | 32 | 27.3 | 81.8 | 12.3 |
| Ireland | | | | | | | 0.0 | |
| Italy | 68 | 0.9 | 31 | 5.0 | 2 | 38.2 | 215.3 | 2.8 |
| Luxembourg | 25 | 0.4 | 53 | 2.5 | 22 | 8.6 | 0.5 | 3.3 |
| Netherlands | | | | | | | 0.0 | |
| Austria | 56 | 0.9 | 41 | 6.4 | 3 | 27.0 | 16.4 | 4.0 |
| Portugal | 75 | 1.3 | 23 | 6.7 | 1 | 66.1 | 38.9 | 3.4 |
| Finland | | | | | | | 0.0 | |
| Sweden | | | | | | | 0.0 | |
| United Kingdom | 92 | 4.7 | 8 | 16.0 | 0 | | 0.1 | 5.7 |
| EU-15 | 57 | 1.3 | 36 | 7.1 | 8 | 29.6 | 466.6 | 5.5 |

Source: Eurostat (Eurofarm), Luxembourg; adaptation LEI.

## 2.4 The use of plant protection products and output from farming

Following a presentation of the structure of farming, we will now examine the role of plant protection products relative to the output of agricultural production.

The intensity of agricultural production is an important feature determining the distribution among agricultural holdings of plant protection products used. Intensive cropping techniques may increase the risks of harvest losses due to pests and diseases, and plant protection products are applied to avert such risks. The efficiency of the inputs used is relevant in the context of the use of agrochemicals. The share of plant protection products costs in total production costs serves as an indicator of the incentive to achieve savings by reducing the inputs used. We will link the expenses made for plant protection with output from farming, examining whether farmers with rather high output per hectare also have high expenses for plant protection. In addition, it allows to judge whether the output of farming is linked to the expenses made on plant protection products.

The incentive to achieve a reduction on the expenditure of plant protection products is likely to be highest where these costs form a considerable part of total costs of inputs used. Costs of plant protection products vary widely among farms. The application depends on the cropping plan, intensity of production, climatic conditions, professional skills of the farmers and the management practices applied, market and price support measures and regulations on the use of agrochemicals, as well as the availability and price of such products. In addition, vulnerability to pests and diseases is an important indicator as well. Figures on the average costs of plant protection products per hectare of land are presented in figure 2.6. The costs of plant protection products exceed 100 ECU per hectare in the Netherlands, the central part of France, the south-eastern part of England, the coastal regions in the southern part of France and in eastern Spain, and northern Italy. These areas mainly include key production regions of specialist horticulture and of cereals production.

The intensity of production is also related to the use of plant protection products. This is due to the fact that intensive-cropping techniques may increase the occurrence of pests and diseases. Farmers might avert such risks by a relatively high usage of plant protection products. Most of the regions with high costs of plant protection products achieve high levels of output. A comparison of the realised crop output per hectare (not including forage crops) in the EU regions (figure 2.7) and the costs of plant protection products per hectare shows that regions with high costs per hectare usually also generate high outputs. The costs of plant protection per 100 ECU of output to grow crops is lowest in the Mediterranean regions with extensive production systems as well as in the Netherlands, with intensive production systems and high outputs from horticulture (figure 2.8).

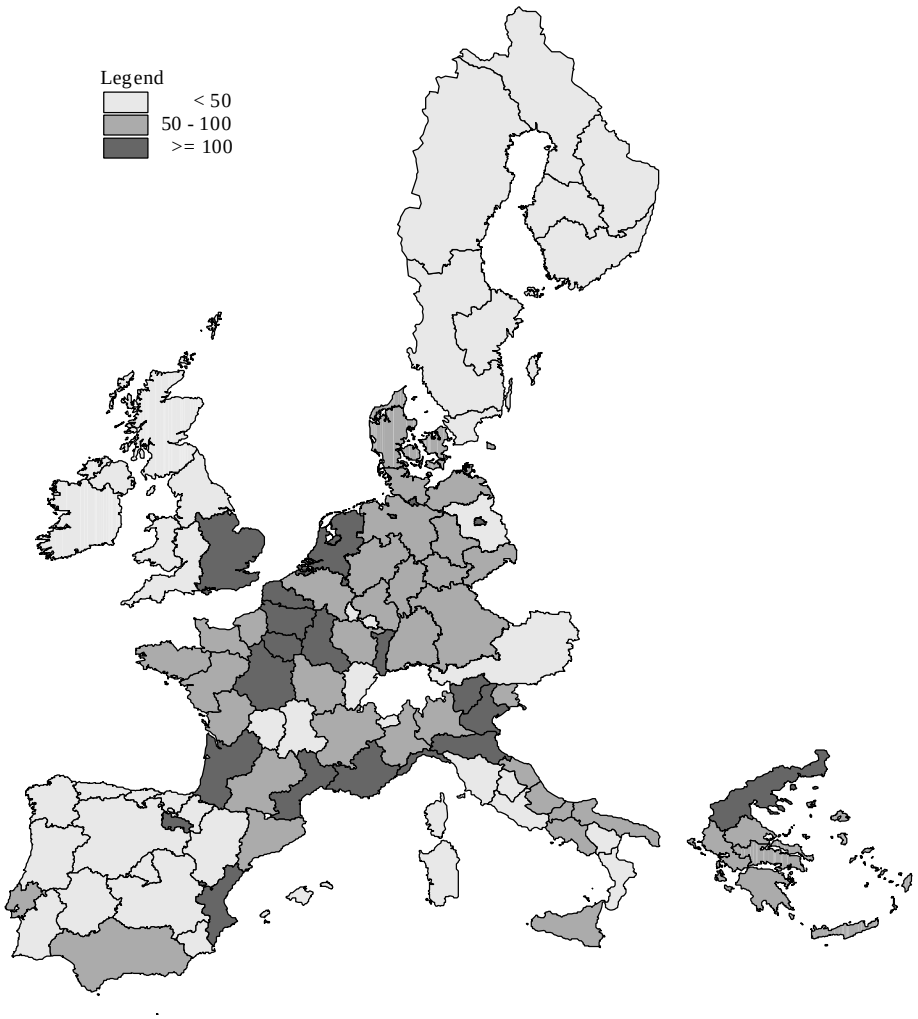



*Figure 2.6 Costs of plant protection products per hectare of utilised agricultural area in the EU in 1994/95-1996/97 a) (ECU/ha)*

*a) 1995/96-1996/97 for Austria, Finland, Sweden and the Neue Bundesländer in Germany*

Source: FADN-CCE-DG Agriculture/A-3; adaptation LEI.

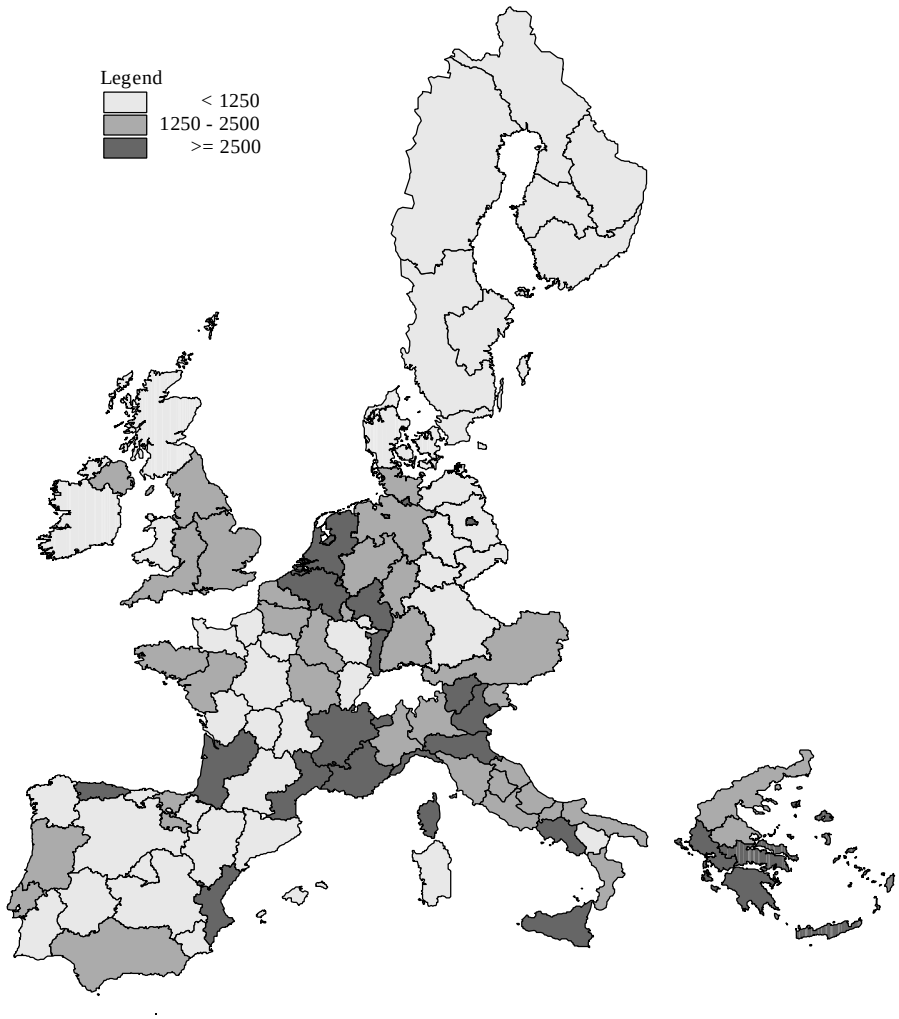



*Figure 2.7 Output of crop production (excluding forage crops) per hectare of utilised agricultural area (excluding forage crops) in the EU in 1994/95-1996/97 a) (ECU/ha)*

*a) 1995/96-1996/97 for Austria, Finland, Sweden and the Neue Bundesländer in Germany*

Source: FADN-CCE-DG Agriculture/A-3; adaptation LEI.

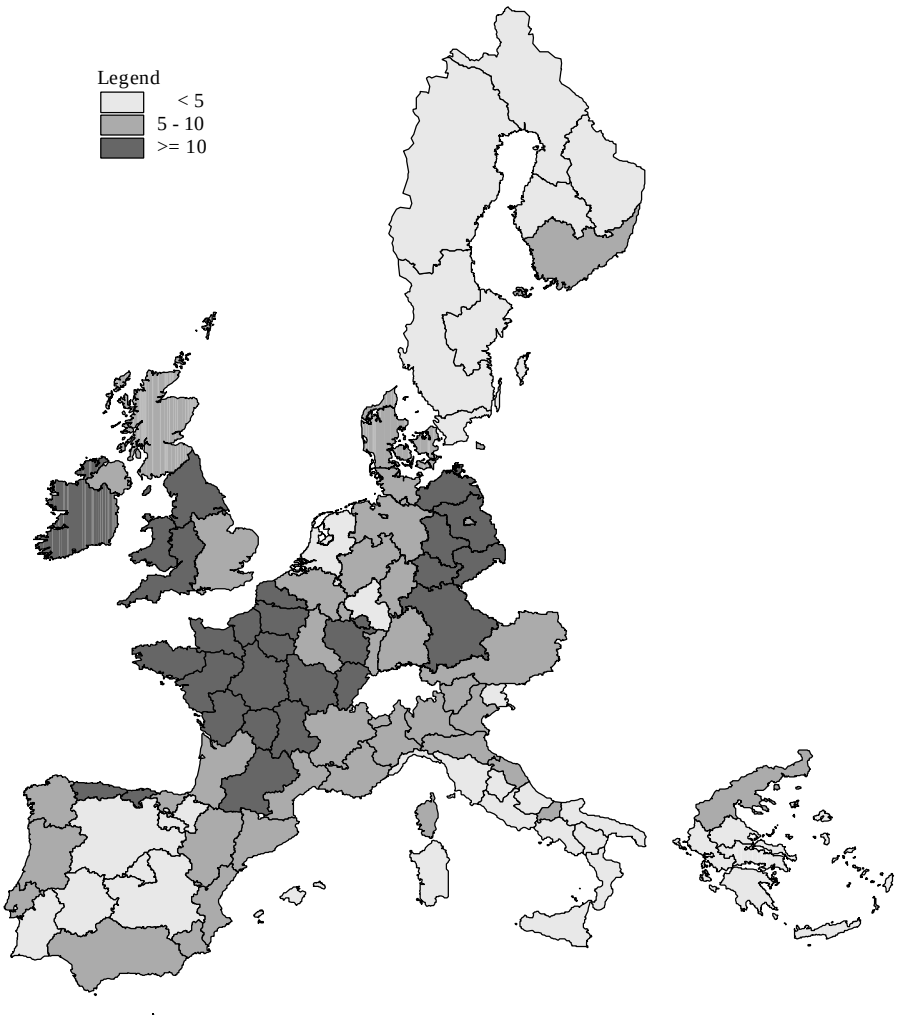



*Figure 2.8 Costs of plant protection products per 100 ECU of output of crop production (excluding forage crops) in the EU in 1994/95-1996/97 a) (ECU)*

*a) 1995/96-1996/97 for Austria, Finland, Sweden and the Neue Bundesländer in Germany*

Source: FADN-CCE-DG Agriculture/A-3; adaptation LEI.

The costs of plant protection products are presented for three farming types: specialist cereals (figure 2.9), specialist horticulture (figure 2.10) and specialist vineyards (figure 2.11). At specialist cereals, these costs are highest - exceeding 100 ECU per hectare - in the Paris Basin, the eastern part of England and parts of Germany, and northern Italy. The costs of plant protection products are a considerable part of total output at this farming type, and exceed 10 per cent in the major production regions of Germany, France and the United Kingdom. Such a high share of these expenses in total output put a strong incentive to achieve savings there, and the use of plant protection products was in fact reduced by almost 15 per cent during the first half of the 1990s.

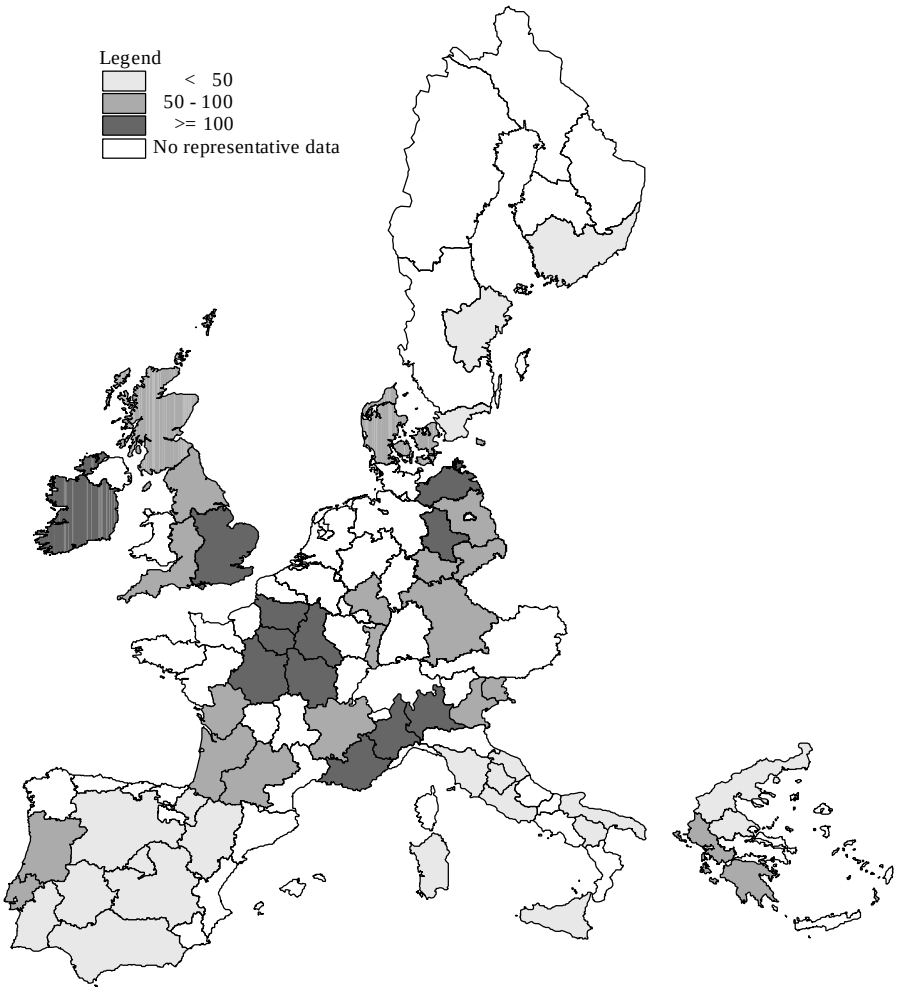



*Figure 2.9 Costs of plant protection products per hectare of utilised agricultural area on specialist cereals (farming type 11) in the EU in 1994/95-1995/96 a) (ECU/ha)*

*a) 1994/95-1995/96, due to the change of this farming type in 1996/97; 1995/96 for Austria, Finland, Sweden and the Neue Bundesländer in Germany*

Source: FADN-CCE-DG Agriculture/A-3; adaptation LEI.

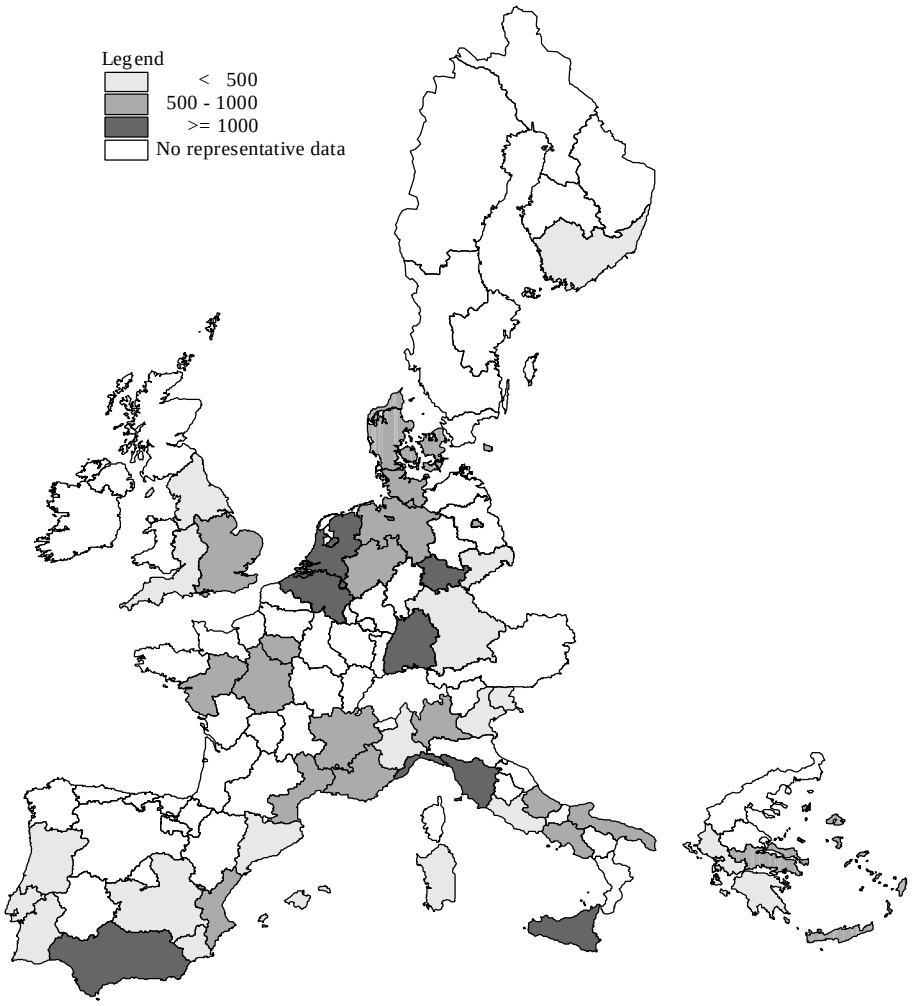



*Figure 2.10 Costs of plant protection products per hectare of utilised agricultural area on specialist horticulture (farming type 20) in the EU in 1994/95-1996/97 a) (ECU/ha)*

*a) 1995/96-1996/97 for Austria, Finland, Sweden and the Neue Bundesländer in Germany*

Source: FADN-CCE-DG Agriculture/A-3; adaptation LEI.

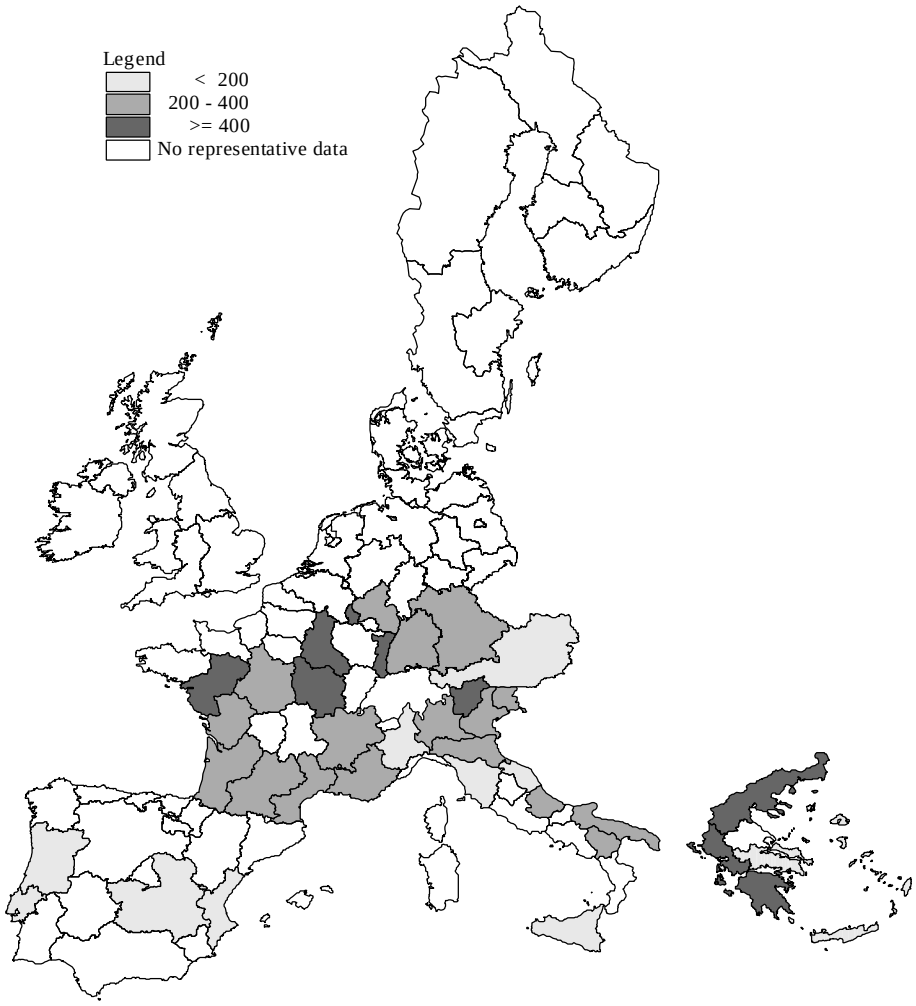



*Figure 2.11 Costs of plant protection products per hectare of utilised agricultural area on specialist vineyards (farming type 31) in the EU in 1994/95-1996/97 a) (ECU/ha)*

*a) 1995/96-1996/97 for Austria, Finland, Sweden and the Neue Bundesländer in Germany*

Source: FADN-CCE-DG Agriculture/A-3; adaptation LEI.

The costs of using plant protection products by specialist horticulture are highest (exceeding 1,000 ECU per ha) in regions with intensive horticulture, such as the Netherlands, Belgium, parts of Germany, southern Spain and some parts of Italy (figure 2.10). The costs of plant protection products in total output of crop production are highest across the coastal zones of the Mediterranean part of the EU. However, this share is around 5 per cent and remains much lower than at cereal farms.

The costs of plant protection in specialist vineyards exceed 400 ECU per hectare in parts of France, Germany and Italy, and in Luxembourg (figure 2.11). Almost all wine produced in Germany, Luxembourg and Austria is accounted for as quality wines, which is not the case in France, Spain and Italy. Rather intensive production methods are applied in Germany and Austria, while extensive production methods are more common in Southern Europe (Rosell and Viladomiu, 2000). The output of specialist vineyards exceed 8,000 ECU per hectare in large parts of France (Aquitaine, Bourgogne and Auvergne) and Germany (Bayern, Rheinland-Pfalz) as well as in Luxembourg.

The costs of plant protection products (ECU per ha) is related to the outputs of crop production. Therefore, the costs of plant protection products will commonly show wide variations across agricultural holdings. Figures 2.12, 2.13 and 2.14 depict the proportional share in costs of plant protection products vis-à-vis in output of plant production of a group of agricultural holdings, if ranked according to output per hectare (exclusive of forage crops). About half of the specialist cereal farms with lowest output per hectare have a share of around a third of total costs of plant protection products (figure 2.12). This group of extensive cereal production holdings has a more than proportional share of output of crop production relative to their costs of plant protection products. About 15 per cent of the group of cereal producers with highest output per hectare have a share of about 20 per cent of output of crop production and a smaller share of costs of plant protection products used. The trend is similar at specialist horticulture (figure 2.13) and specialist vineyards (figure 2.14).

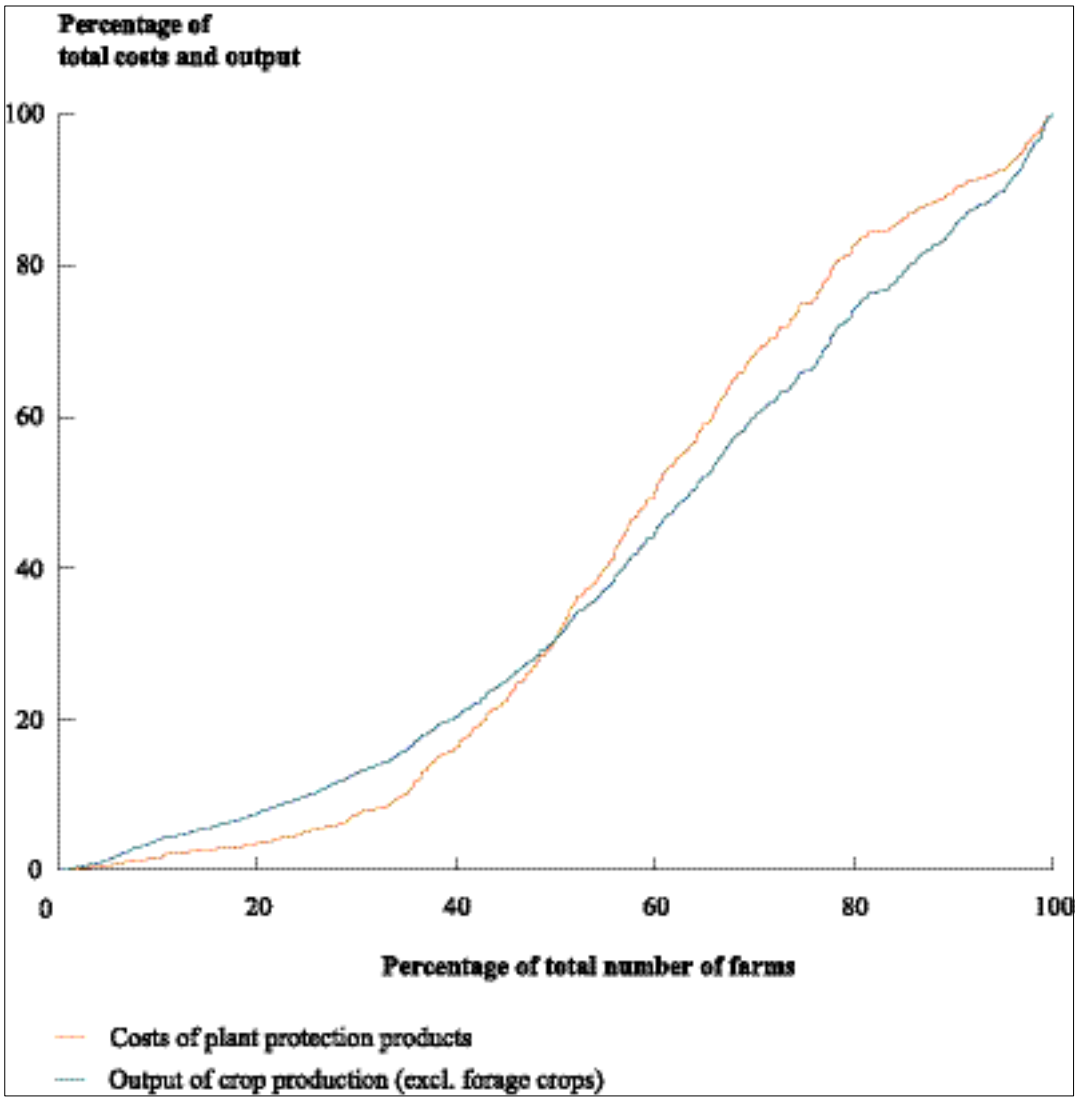



*Figure 2.12 Specialist cereals in 1995/96*
Source: FADN-CCE-DG Agriculture/A-3; adaptation LEI.

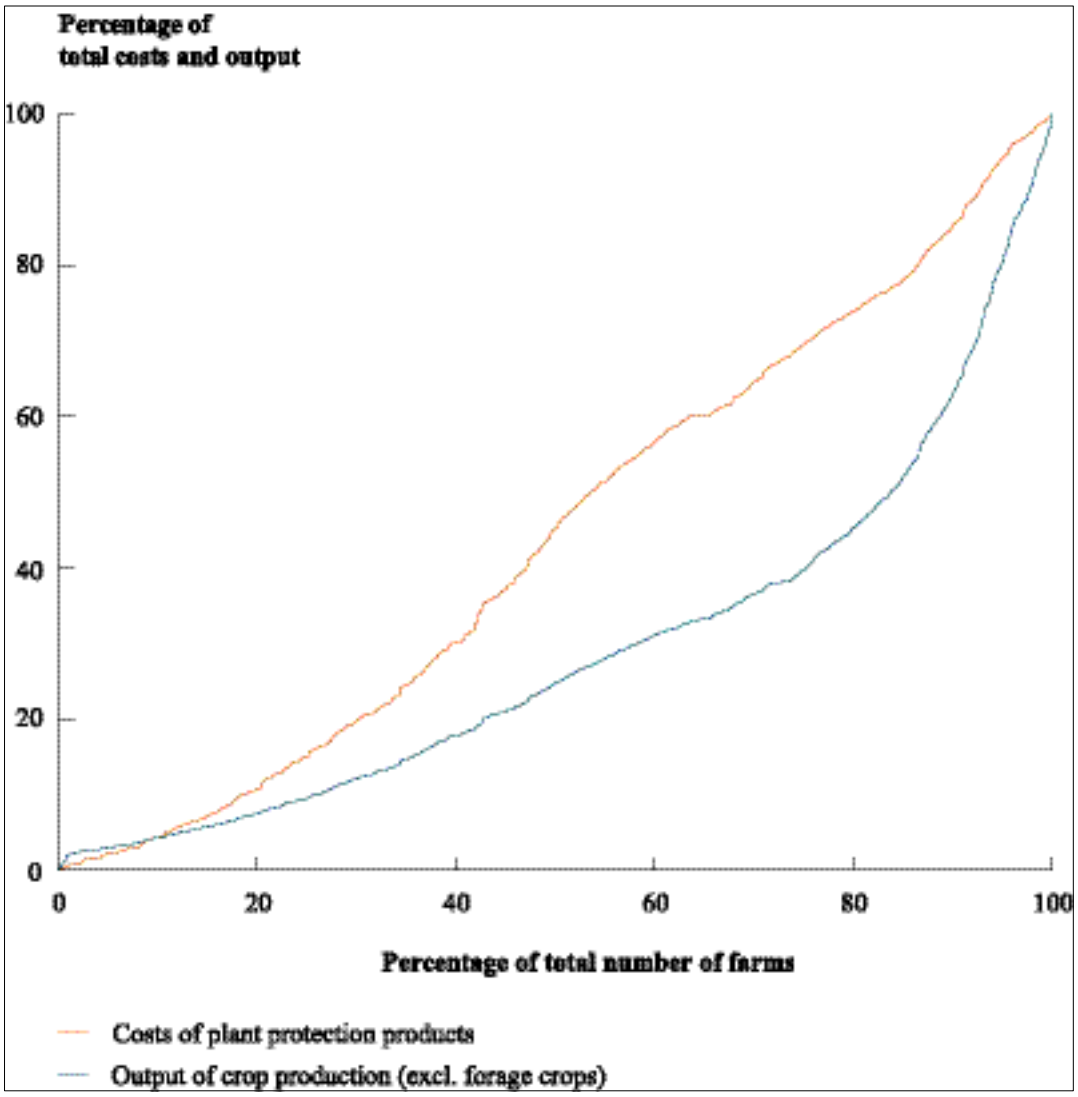



*Figure 2.13 Specialist horticulture in 1996/97*
Source: FADN-CCE-DG Agriculture/A-3; adaptation LEI.

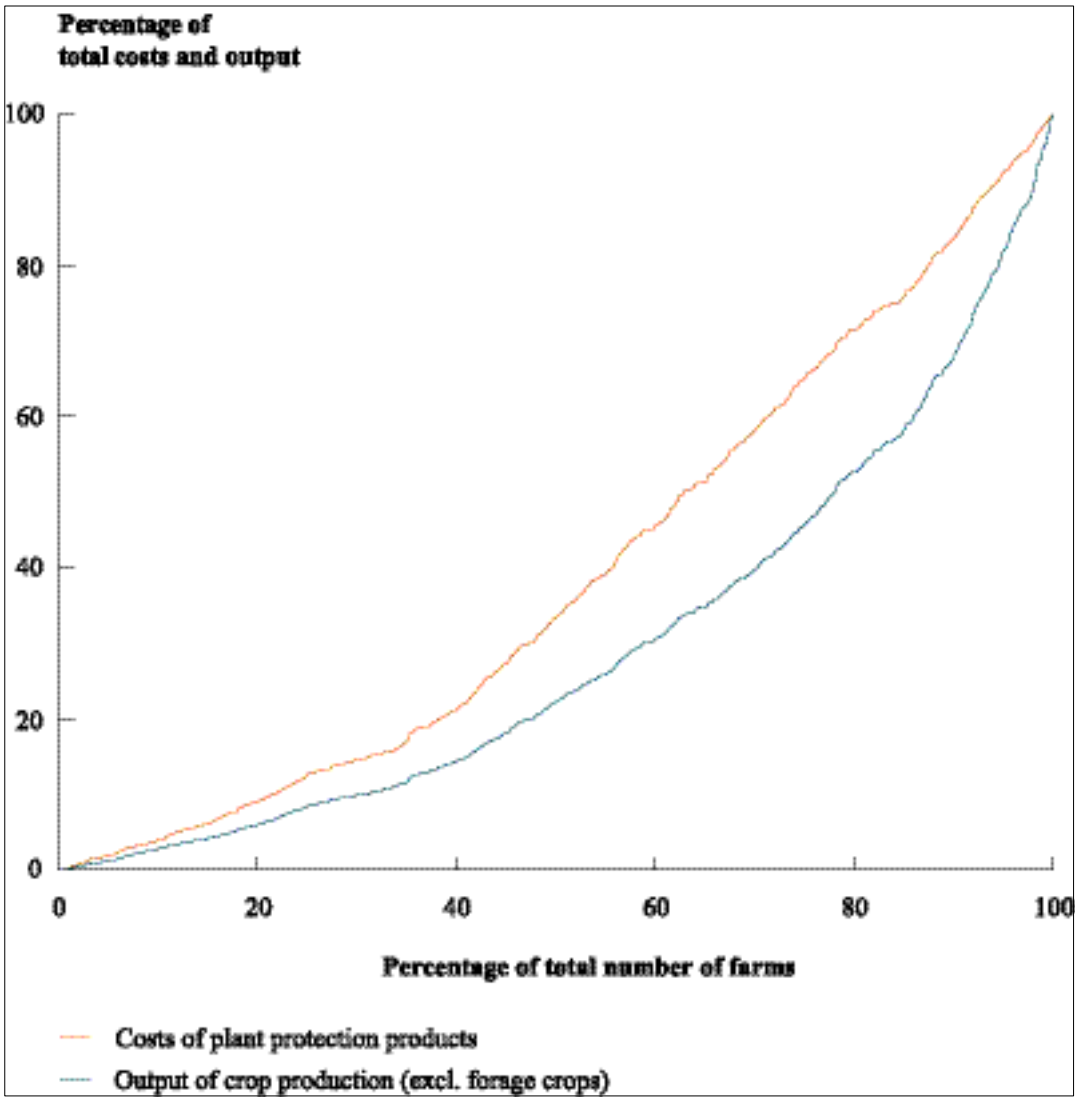



*Figure 2.14 Specialist vineyards in 1996/97*
Source: FADN-CCE-DG Agriculture/A-3; adaptation LEI.

The group of specialist horticulture holdings with lowest output has a more than proportional share in costs involved of using plant protection products (figure 2.13). This also applies to specialist vineyards (figure 2.14). About half of the specialist horticulture holdings have a share of only some 25 per cent of crop output, and about 45 per cent of total costs of plant protection products. In contrast, the group of holdings with highest output of crops generate high outputs relative to the costs for plant protection products. Ten per cent of the specialist horticulture holdings with highest output of crop production have a share of almost 40 per cent of

crop output. This group of holdings, however, do have a share of some 15 per cent of total costs of plant protection products (figure 2.13). A similar trend is observed at specialist vineyards (figure 2.14). About half of the specialist vineyard holdings with lowest output per hectare, in total have a share of only 20 per cent of output of crop production. This group of holdings apply around a third of total costs of plant protection products of this farming type. Again, 10 per cent of the specialist vineyards with highest output of crop production per hectare, in total have a third of crop production, and taking less than a quarter of the costs of plant protection products. To summarise, we may conclude from figures 2.12 - 2.14 that agricultural holdings with highest output per hectare and therefore have a more than proportional share of output generated by that farming type, generally have a less than proportional share of plant protection products.

## 2.5 Trends on the use of plant protection products

Some trends on the use of plant protection products are presented in this section, and key driving forces for change are examined. Total use of plant protection products was around 326 million kg of active ingredients (1991) (table 2.11), which dropped to around 285 million kg in 1995 and increased in 1996 to a total of 300 million kg (table 2.12). Usage of plant protection products, however, reduced by some 13 per cent between 1991 and 1995 and increased in 1996 at least in part due to climatic conditions (i.e. rainfall). Some divergent trends are observed across Member States.

*Several factors contributed to reduce usage of plant protection products*

The usage of plant protection products, however, increased during the first half of the 1990s in Greece, Ireland, Portugal and the United Kingdom. Several factors have contributed to this downward trend in the EU:

- First, innovations allowed for the provision of new compounds that require lower dosages. Several active ingredients have been authorised for agricultural use and entered the market during the 1990s. In part, they replaced active ingredients for which authorisation expired. Such chemical substitution is likely to be one of the major reasons of the reduction in use. A smaller amount of active ingredients per hectare nowadays suffices to treat plants compared to what was used in the past.
- Second, improved application technologies allowed improving the effectiveness of treatment against weed, insects and diseases. The application of the MLHD-approach ('Minimal Lethal Herbicide Dosage'), for example, allowed reducing the use of herbicides by approximately 50 per cent. Mechanical weed-control methods are currently used in the Netherlands on about two thirds of the area to grow tree nursery crops. In total, it is used on almost a quarter of the land to grow horticultural crops in the open (Eurostat, 1998).

- Third, changes in farm management practices (including the use of Integrated Crop Management practices and Integrated Pest Management). IPM is 'an ecologically based pest management approach that promotes the health of crops and animals and makes full use of natural and cultural control processes and methods, including host resistance and biological control. It uses chemicals only when the measures mentioned above fail to keep pests below damaging levels. Important components of integrated control are natural forms of control, such as crop rotation and resistant varieties of seed' (Haskoning, MTI and LEI, 1999). In the region of Emilia-Romagna, for example, integrated production methods are currently applied on about 20 per cent of the area to grow fruit. The use of plant protection products is reduced through the application of agronomic, genetic and biological techniques.

*Table 2.11 Sales of plant protection products in 1991 by Member State (in tons of active ingredients)*

| Country | Fungicides | Herbicides | Insecticides | Other | Total |
|---|---|---|---|---|---|
| Belgium | 2,837 | 5,091 | 1,167 | 874 | 9,969 |
| Denmark | 1,426 | 2,867 | 146 | 189 | 4,628 |
| Germany | 9,760 | 18,999 | 3,968 | 4,217 | 36,944 |
| Greece | 2,530 | 2,080 | 2,150 | 1,100 | 7,860 |
| Spain | 11,582 | 13,747 | 9,178 | 4,640 | 39,147 |
| France | 55,565 | 33,713 | 10,673 | 3,483 | 103,434 |
| Ireland | 535 | 1,097 | 163 | 211 | 2,006 |
| Italy | | | | | 58,123 |
| Luxembourg | 113 | 121 | 10 | 9 | 253 |
| Netherlands | 4,282 | 3,312 | 8,273 | 1,440 | 17,306 |
| Austria | 1,843 | 2,167 | 157 | 321 | 4,488 |
| Portugal | 6,511 | 1,801 | 831 | 212 | 9,355 |
| Finland | 146 | 1,375 | 64 | 149 | 1,734 |
| Sweden | 723 | 1,054 | 19 | 41 | 1,837 |
| United Kingdom | 6,518 | 18,262 | 1,854 | 2,388 | 29,022 |
| EU-15 | | | | | 325,653 |

Source: Eurostat (1998).

- Fourth, national mandatory reduction schemes also contributed to the reduction of usage of plant protection products. Four countries have formulated policy targets to reduce the use of such products, including Denmark, Finland, the Netherlands and Sweden. Limitations on the use of soil disinfection have contributed largely to the major reductions in using nematicides in the Netherlands.

*Table 2.12 Sales of plant protection products in 1996 by Member State (in tons of active ingredients)*

| Country | Fungicides | Herbicides | Insecticides | Other | Total |
|---|---|---|---|---|---|
| Belgium | 2,402 | 5,953 | 1,199 | 849 | 10,403 |
| Denmark | 631 | 2,915 | 31 | 87 | 3,664 |
| Germany | 10,404 | 16,541 | 3,929 | 4,211 | 35,085 |
| Greece | 3,248 | 2,717 | 2,440 | 1,465 | 9,870 |
| Spain | 10,165 | 8,652 | 9,758 | 4,661 | 33,236 |
| France | 48,625 | 36,052 | 5,399 | 2,813 | 92,889 |
| Ireland | 750 | 1,126 | 76 | 616 | 2,568 |
| Italy | 25,074 | 9,888 | 8,992 | 4,096 | 48,050 |
| Luxembourg | | | | | |
| Netherlands | 3,624 | 3,016 | 2,256 | 1,022 | 9,918 |
| Austria | 1,697 | 1,536 | 98 | 235 | 3,566 |
| Portugal | 9,746 | 1,584 | 727 | 400 | 12,457 |
| Finland | 115 | 677 | 55 | 86 | 933 |
| Sweden | 253 | 1,236 | 13 | 27 | 1,528 |
| United Kingdom | 6,885 | 24,180 | 1,730 | 2,865 | 35,659 |
| EU-15 | 123,619 | 116,073 | 36,702 | 23,432 | 299,826 |

Source: Eurostat (1998).

- Fifth, market initiatives also stimulate the environmental awareness of producers. Such market responses could be seen as pro-active responses to government regulation and to consumer preferences for environmentally friendly products. Several initiatives exist across the EU. In the Netherlands, for example, the Floriculture Environmental Programme (Milieu Programma Sierteelt) for example, stimulates environmental awareness in the cultivation of flowers, plants, bulbs and nursery stock products (MPS, 1999). The programme essentially requires producers to keep records on the inputs they use. The programme has a broad participation from primary producers. The use of plant protection products has been reduced by some 25 per cent in a few years. Similar efforts exist for other sectors (e.g. bulb growing and tree cultivation). In addition, retailers increasingly demand the use of environmentally friendly conditions in cultivation methods used in primary production of fresh produce (see chapter 3).
- Sixth, the reform of agricultural policy reduced intervention prices of cereals, oilseeds and protein crops. An investigation by Falconer and Oskam (2000) provides evidence of the limited impact of agricultural policy reform during the 1990s (mainly the arable crops regime) on total use of plant protection products in the EU. They estimated a reduction of only around 3 per cent, which could be accounted for by the reform in 1992 of the arable crops regime. A reduction of cereal prices by a third would decrease the use of plant protection products by around 7 per cent. In addition, the set-aside requirements

of about 6 per cent of the production capacity of cereals, oil seeds and protein crops in total would reduce the use of plant protection products by around 2 per cent. The combined effect of the price reduction and the set-aside requirements would reduce the use of plant protection products in arable crops by almost 10 per cent.

Climatic conditions can largely affect the use of plant protection products to control pests and diseases. Dry climatic conditions in Spain during the first half of the 1990s have contributed to the reduction in usage. The use of plant protection products again went up in 1996 following the end of several years of drought.

*Plant protection products remain of economic importance to the farming community*

According to estimates provided by FAO, the global loss of potential crop yields to pests, weeds and diseases is estimated at 60 per cent. Loss before harvest is 40 per cent and loss after harvest is 20 per cent. Such features indicate the need to control pests and diseases at the stage of production, as well as during storage to maintain quality and increase the period for storage. Chemical sprout inhibitors, for example, are applied during storage of potatoes, allowing suppressing the sprouting process. Rigorous analyses regarding the various options to control the use of plant protection products remain scarce. Limited information is available so far on the economic benefits of using plant protection products in the EU. A detailed analysis to evaluate the consequences of different strategies to reduce the use of plant protection products is offered for Denmark (EPA, 1999). Four scenarios are assessed in this study:

- Total phase-out of these products (0 scenario). The assessment indicates that such a scenario would entail a loss in gross factor income to the agricultural sector of USD 500 million and 16,000 jobs. Gross factor income in farming and processing would be reduced by some 11 per cent, although the reduction would be around 40 per cent in crop production. Also, prices of potatoes and sugar beet would increase by some twenty to 30 per cent. Employment in cash crops would be less than half of that of the reference period. The report considers a total ban on plant protection products not to be realistic unless numerous international rules - including the Treaty of Amsterdam - would be amended. Rules to ban the use of plant protection products need to be based on sound science, considering environmental or health-related aspects only.
- Reduction in the frequency of treatment [1]) to 0.5, which would reduce the use of plant protection products by 80 per cent (+ scenario). The use of plant protection products would be allowed only in cases where abstaining from treatment will cause major harvest losses. Implementation of this scenario would reduce gross factor income from agriculture by USD 260 million (4 per cent reduction in total gross factor income in farming and processing), and reduce agricultural employment by 8,000 persons. Gross

[1] The treatment frequency is the average number of times the land can be treated with normal dosages. It is based on total sales of a compound for a specific crop, the recommended dosage per hectare per application and the acreage of that crop.

factor income from crop production would be reduced by 20 per cent. This scenario implies employment in cash crops to be reduced by almost 30 per cent, and employment in primary agriculture and processing is reduced by 7 per cent.

- Reduction in the treatment frequency to 1.4 - 1.7, which would be equivalent to a reduction in the use of plant protection products by 34-49 per cent (++ scenario). This scenario is based on targeted use of plant protection products without loss of crops yields. This scenario could be implemented without major additional costs to the farming sector neither to society. Investments in machinery would be needed for mechanical weed control and to limit emissions from application.
- Conversion to organic production methods within a period of 30 years (organic farming scenario). Total costs to society for the implementation of this scenario would be USD 1,600 - 3,700 million, depending on how much fodder would have to be imported.

The Bichel Committee recommends the optimised use of plant protection products, which is merely based on the ++ scenario. This scenario is proposed for the next 5 - 10 years, which could become operational without major costs to the farming community. In addition, it is recommended to stimulate the conversion to organic production methods. Also, specific measures are proposed to control the emissions of plant protection products to watercourses (e.g. by establishing no-spray zones near watercourses).

## 2.6 The importance of the European plant protection industry

In recent years the European plant protection industry has experienced considerable structural changes. The industry went through an active phase of mergers and de-mergers, acquisitions, joint ventures, collaborations and strategic alliances, and further internationalisation. Major explanations for this restructuring can be found in technology and market developments. Biotechnology, and particularly the possibilities of genetic engineering and functional genomics, has not only opened new routes for developing plant protection products, it has also lead to the intra-company combination of plant protection and plant breeding. On the market side, producers of plant protection products have been faced with stagnant or even declining markets (at least in the developed countries) and with more stringent environmental policies.

In 1996, the world market for plant protection products was about 31 billion USD (Wood Mackenzie, 1997). The EU share of the market is around 25 per cent, or 8 billion USD. Western Europe and North America account for 56 per cent of the world market. The EU, USA, Japan and Brazil account for about three-quarters of the global market of agrochemicals (Wood Mackenzie, 1997). Within the EU France is the largest user with 8 per cent of the world market, and Germany the second with largest user, with a 4 per cent world market share. As the producers of crop protection products are global companies, their product innovation is affected by regulatory requirements in various regions of the world. The fungicide azoxystrobin, for example, has been registered under the safety standard established by the

Environmental Protection Agency in the USA, which did change with the new US Food Quality Protection Act from 1996. This fungicide has been a candidate for rejection in the R&D phase, because it might not meet the requirements of the EC Drinking Water Directive which sets a limit of 0.1 µg per litre (Tait, 2000). The European Union is a net exporter of crop protection products, mainly fungicides, followed by insecticides and herbicides (table 2.13). The largest net exporters of crop protection products are Germany, France, the United Kingdom, Belgium and the Netherlands. These countries count for about 70 per cent of total export to non-EU countries (Eurostat, 1998). Greece is the largest importer of crop protection products, followed by Spain and Italy. The export to non-EU countries is mainly for markets in Asia, Central and Eastern Europe, North America, and Central and South America (Eurostat, 1998).

*Table 2.13 Export and import of plant protection products (in million Euro)*

| | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|
| Total export | 4,930 | 5,397 | 5,273 | 5,768 | 5,770 |
| - Intra trade | 2,990 | 3,179 | 2,962 | 3,349 | 3,533 |
| - Extra trade | 1,940 | 2,218 | 2,311 | 2,419 | 2,237 |
| Total import | 3,577 | 3,770 | 3,806 | 4,183 | 4,343 |
| - Intra trade | 2,959 | 3,067 | 3,139 | 3,534 | 3,610 |
| - Extra trade | 618 | 704 | 667 | 649 | 732 |

Source: Eurostat.

The EU market for plant protection products was decreasing in the early 1990s, and is more or less stable since the mid-1990s (Wood Mackenzie, 1997). Other developed countries also show a diminishing (e.g., Japan) or slow growing (e.g. USA) market for plant protection products. Several developments have caused the stagnation of slow growth. First, starting in the 1980s, but really gaining momentum in the 1990s was the societal and governmental attention for harmful environmental effects of the use of plant protection products. There is now a strong demand to reduce the use of plant protection products, and to substitute chemical pest control by various methods of IPM. Second, since the early 1990s, support prices for crops in the EU have declined as part of the restructuring of the CAP. Also set-aside measures have been introduced to reduce excess supplies. Third, at the turn of the century agricultural prices are at an all time low, partly as a result of policy measures, partly as a result of lower demand (due to economic crisis in Asia and Latin America).

While markets do not grow, the costs of R&D and registration are increasing steadily. New technological developments in chemistry and biotechnology require companies to spend more money on research. At the same time, stricter registration processes lead to more expensive development (including testing) of new products. The result is that more compounds have

to be screened nowadays than 10 years ago. Industry sources indicate that only 1 out of 200,000 compounds lead to a new agrochemical, and that the costs of developing a new plant protection product is mounting to 100 million USD. As investments needed to develop a new plant protection product are rising, firms are pressed to seek opportunities to expand their sales.

In the current stagnant or even declining markets, firms have chosen the following strategies to obtain the necessary scale. First, they have merged with and/or acquired other companies. This generates the higher sales and sometimes a broader product portfolio needed to sustain R&D investments. Second, firms have expanded their international activities, by setting up subsidiaries in other countries, by acquiring local companies, or engaging in marketing alliances with local (or locally present international) companies. A global presence is an absolute requirement for the major players in the chemical plant protection market.

The rising R&D costs, in combination with stagnant markets, has also reinforced the focus of the large multinationals on major agricultural crops. Most new product development is targeted at crops that are cultivated on a large scale, like cereals (wheat, maize, rice), oilseed crops (soybeans, canola) and cotton. This, again, has strengthened competition among the large producers, who respond by further restructuring and international expansion. This focus on the major agricultural crops in product development has an impact on the availability of plant protection products for minor crops, particularly vegetable and fruit crops. Plant protection products for minor crops are almost always developed on the basis of the active ingredients for the major crops. Stronger focus on major crops in combination with increasing registration costs lead to fewer products becoming available for minor crops.

A result of the further globalisation of the chemical plant protection industry is the greater attention for differences in registration procedures and requirements in the various target markets. Even for European companies, registration requirements of the US have become crucial for decisions on product development. Differences in registration may lead to uncertainties about whether new products can be sold worldwide. As many agricultural products are traded internationally, a new plant protection product may not be commercially viable although it is approved.

In 1996, more than 30,000 persons were employed in the crop protection industry in Western Europe. European-based companies are among the largest producers of plant protection products in the world (table 2.14). At the end of 2000, the two largest producers are Syngenta and Aventis. Syngenta is the October 2000 merger of Novartis Agribusines (plant protection products, seeds, plant biotechnology) and Zeneca Agrochemicals (the plant protection unit of AstraZeneca). Novartis and Zeneca (which merged with Astra in 1999) already were the first and third largest producers of plant protection products in 1998. Aventis is the December 1999 merger between Rhône-Poulenc and Hoechst, where Aventis CropScience combines the plant protection activities of Rhône-Poulenc Agro and AgrEvo. AgrEvo was the former plant protection joint venture of Hoechst and Schering. Other major European agrochemical companies are the German companies BASF and Bayer. In July 2000, BASF acquired Cyanamid, the agrochemical division of American Home Products.

*Table 2.14 Plant protection product industry top 10 (world-wide, 1999)*

| Company | Sales (in million USD) |
|---|---|
| 1 Aventis CropScience | 4,320 |
| 2 Novartis | 3,753 |
| 3 Monsanto | 3,214 |
| 4 Zeneca Agrochemicals (AstraZeneca) | 2,657 |
| 5 Bayer | 2,316 |
| 6 DuPont | 2,099 |
| 7 Dow AgroSciences | 2,088 |
| 8 BASF | 1,856 |
| 9 Cyanamid (American Home Products) | 1,669 |
| 10 Makhteshim-Agan | 720 |

Source: WoodMacKenzie.

Part of the mergers and acquisitions by producers of plant protection products cannot be explained by looking at developments in the plant protection market only. Agrochemicals are produced by companies, which are also engaged in the production of pharmaceuticals and other chemicals. For instance, BASF (before the Cyanamid acquisition) and Bayer have total turnover 10 times as large as their agrochemicals sales. Both are major producers of bulk and fine chemicals, and Bayer also has a large pharmaceutical division. The merger between Hoechst and Rhône-Poulenc was partly triggered by the need to build up market power in the US pharmaceuticals market. Interaction between agrochemical industry and pharmaceutical industry is particularly important for those companies that follow the life sciences strategy.

Life science companies use their knowledge of living organisms to produce seed and agrochemicals for plant production, veterinary products for animals, and diagnostic and therapeutic products for human health care (Bijman, 1999). The life science strategy was first adopted by the US company Monsanto, but it were the European agrochemical and pharmaceutical companies like Novartis, Zeneca, Aventis, Bayer and BASF that vigorously pursued this strategy. Life science companies have heavily invested in biotechnology research, as it is biotechnology that allows for the combined application of knowledge derived from the various life science disciplines. The synergy of technologies such as functional genomics and bioinformatics in crop enhancement and in developing new therapeutic proteins for human health care are now widely acknowledged, especially since the development of all of these products requires major R&D investment in genetics, biology and chemistry.

However, in recent years doubts have been raised over the wisdom of putting all the diverse life science activities into one company. From the marketing point of view the life science strategy is questioned because the markets for agricultural products and for health products are very different, in size, in growth perspective and in profitability. The markets for

agrochemicals as well as seeds show slow growth (if growth at all), while pharmaceutical markets are growing rapidly. Also the concerns of the European public over genetically modified crops does not make the prospects of recouping the huge investments of agrochemical companies in biotechnology very promising. Pharmaceutical companies may even consider it a liability to be engaged in a business that encounters so much opposition as the genetically modified crops do. Novartis and AstraZeneca have been the first to reconsider their life science strategy. They have now put their agribusiness activities (plant protection, seeds and plant biotechnology) at arm length in the newly formed joint venture Syngenta.

## 2.7 Concluding remarks

Primary agriculture is no longer a major economic sector in the EU and currently contributes to a limited share of GDP in most Member States. The volume of agricultural production however steadily increased over time. Intensification of production and increasing use of agrochemicals allowed to increase production and meanwhile also to reduce labour demand. Although steadily decreasing over time, agriculture remains the dominant user of land in most European countries. More than 6 million people are currently employed in the agrifood sector (crop production) and the gross value added of that sector exceeds 200 billion Euro.

Numerous factors have contributed to the adoption of farming practices to optimise the use of plant protection products. Farm management factors (including skills of farmers) are important features to guide farmers in their attempts to optimise the control of pests and diseases, and offer food at reasonable costs and also maintaining product quality and increase the storage period. IPM schemes, for example, allow to substantially reducing the usage of plant protection products relative to conventional farming practices. The incorporation of IPM approaches with farm management factors allowed introducing major reductions in use of plant protection products in the Netherlands. IPM is widely adopted in the USA as it is one of the main goals in the food safety legislation developed during the 1990s and about 75 per cent of the cropland should be under IPM by the year 2000. The adoption of IPM remains more localised in the EU. In Spain, participation into IPM is offered financial support in selected environmentally sensitive areas, which currently covers some 15,000 ha and compensatory payments of some 230 ECU per hectare (Haskoning, MTI and LEI, 1999).

The rational use of plant protection products supports the farming community to the specialisation of production and to gain from concentration of production in regions with competitive advantages and subsequently to increase trade on the international market. It contributes to maintain the quality of food and also to increase the period to store products after harvest. Farmers with highest output per hectare have a less than proportional share of the expenses for plant protection products.

# 3. How food processors and food retailers influence on-farm use of plant protection products

## 3.1 Introduction

Food processors and food retailers increasingly exert influence on the use of plant protection products by farmers. In response to consumer concerns about the quality of food, processors and retailers require that supplying farmers apply more sustainable production methods. A reduction of the use of plant protection products is one of the main elements in this trend towards selling food products with an enhanced environmental profile.

In this chapter we will discuss the trend among food processors and food retailers to raise the requirements for farm products. These requirements seem to be most elaborated for fresh produce. We are particularly interested in the effect of this trend on the use of plant protection products by farmers. We will present a general analysis of the trend, as well as several examples of companies collaborating with suppliers in raising product quality standards. These examples have been chosen from three different countries: the Netherlands, the United Kingdom and France. The UK and the Netherlands were chosen because they are most advanced in retailers demanding special cultivation practices from their suppliers, and the recent trend in these two countries might be adopted at much wider scales in the EU within the next decade or so. France was chosen because it is a large agricultural producer, it has large food processing and food retail industry. Although we planned to include German companies in our brief survey, we could not find suitable examples. German retailers seem to be competing on price rather than on quality.

The structure of the report is as follows. In section 3.2 we will present some general background information on consumption trends in the EU, with special attention for the consumption of fresh produce. In this section we will also discuss the (recent) developments in consumer concerns about quality of both the food product itself and the production methods used in farming. In section 3.3 we discuss the strategies that food processors and food retailers have developed in response to consumer concerns. Next, in section 3.4, we discuss several structural changes in the agrifood sector, like consolidation processes among retailers, internationalisation among food processors, and more vertical co-ordination throughout the whole agrifood production and distribution chain. In section 3.5, 3.6 and 3.7, examples from the Netherlands, the UK and France are presented. Finally, in section 3.8 we present the conclusions on food processors and food retailers influencing on-farm use of plant protection products.

## 3.2 Food consumption, patterns of trade and consumer concerns

*Consumption and patterns of trade*

While in chapter 2 figures and trends on production of agricultural products have been presented, this chapter focuses on distribution and consumption issues. To find out how consumer markets influence on-farm use of plant protection products, we have to know through which marketing and distribution channels farm products are sold, and by which consumers they are purchased. With substantial intra-European trade in agricultural products, consumer valuation of (or concern about) plant protection products not only influences cultivation decisions of regional and domestic farmers, but also has an impact on the use of plant protection products by farmers in other countries. In the Netherlands, about two-thirds of all organic produce is exported, mainly to Germany and the UK (PT, 2000). Producers of organic fruit and vegetables in the Netherlands are therefore more responsive to consumer trends in the importing countries than to domestic consumer demands.

Food consumption patterns differ substantially among EU Member States. For instance, consumption of potatoes ranges from 40 kg per capita in Italy to almost 180 kg in Ireland (table 3.1). The EU average potato consumption is 77 kg per capita. The inhabitants of southern European states typically consume more Mediterranean products like pasta's and bread, wine, vegetables and fruit (INEA, 1999).

*Table 3.1 Consumption of vegetables, fruit and potatoes, 1996/1997, kg per capita*

| Country | Vegetables | Fruit | Potatoes |
|---|---|---|---|
| Belgium/Luxembourg | 111 | 26 | 93 |
| Denmark | na | na | 57 |
| Germany | 88 | 16 | 73 |
| Greece (94/95) | 308 | 18 | 94 |
| Spain | 168 | na | 89 |
| France | na | 20 | 58 |
| Ireland | 90 | 13 | 178 |
| Italy (95/96) | 175 | 22 | 38 |
| Netherlands (95/96) | 94 | 21 | 85 |
| Austria | 90 | 20 | 56 |
| Portugal | 125 | 27 | 138 |
| Finland | 61 | na | 77 |
| Sweden | 63 | 13 | 84 |
| United Kingdom (95/96) | 96 | 13 | 107 |

Source: Eurostat; na: not available.

Not only food consumption differs among EU Member States; also the percentage of income spent on food, beverages and tobacco shows rather large differences. While German households spent less than 10 per cent of their income on food, the Portuguese spend more than 21 per cent on food (table 3.2). Households in the other Southern European countries, on average also spend a relatively larger part of their income on food. Table 3.2 shows similar patterns as table 3.1, regarding the expenditures on fruit and vegetables: consumers in southern European countries spend a larger share of their incomes on fruit and vegetables, relative to consumers in the north.

Detailed figures on the volume of production and consumption of vegetables, fresh fruit and potatoes are presented at Member State level in tables 3.3, 3.4 and 3.5. The tables indicate so-called supply balance sheets. A complete supply balance sheet shows domestic production, import, export, consumption, and parts of production being lost or being fed to animals. The latter category has been left out for presentation reasons. The self-sufficiency rate, as given in the last column of tables 3.3, 3.4 and 3.5 is production as a percentage of consumption. Countries that produce more than they consume show a self-sufficiency rate of more than 100 per cent.

*Table 3.2 Household expenditures on food, beverages and tobacco as % of total income (1997)*

| Country | Food | Fruit and vegetables | Beverages and tobacco | Total food, beverages and tobacco |
|---|---|---|---|---|
| EU-15 | na | na | na | 17.4 |
| Belgium | 13.0 | 1.9 | 3.3 | 16.3 |
| Luxembourg | na | na | na | 18.2 |
| Denmark (1996) | 14.0 | 1.9 | 5.6 | 19.7 |
| Germany | 9.9 | na | na | 13.9 |
| Greece | 16.5 | 3.8 | 4.9 | 21.3 |
| Spain | na | na | na | 18.6 |
| France | 13.9 | 1.9 | 4.0 | 17.9 |
| Ireland | 14.3 | 1.8 | 16.2 | 30.5 |
| Italy | 15.1 | 3.3 | 3.0 | 18.1 |
| Netherlands | 10.7 | 1.9 | 3.4 | 14.1 |
| Austria | 12.4 | 2.0 | 3.8 | 16.3 |
| Portugal (1995) | 21.5 | 2.8 | 5.6 | 27.0 |
| Finland | 13.0 | 2.2 | 6.1 | 19.1 |
| Sweden | 13.4 | 2.2 | 5.1 | 18.4 |
| United Kingdom | 10.5 | 1.7 | 9.5 | 19.9 |

Source: Eurostat; na = not available.

Tables 3.3 to 3.5 also show great differences among EU Member States in production and consumption of vegetables, fresh fruit and potatoes. As a result, trade figures and self-sufficiency rates vary substantially. Table 3.3 shows that Italy and Spain are by far the largest producers of vegetables. The production levels in these countries substantially exceed national consumption. The Netherlands also is a major net exporter of vegetables, while Germany, the United Kingdom, Sweden and Austria are major net importers. Portugal is a net exporter of vegetables. France is a net exporter of vegetables, although no data are available on that country from EUROSTAT.

*Table 3.3 Supply balance sheet vegetables, 1996/1997 (1,000t)*

| Country | Production | Import | Export | Consumption | Self-sufficiency rate (%) |
|---|---|---|---|---|---|
| Belgium/Luxembourg | 1,504 | 1,158 | 1,365 | 1,173 | 128 |
| Denmark | na | na | na | na | na |
| Germany | 3,327 | 5,064 | 463 | 7,223 | 46 |
| Greece (94/95) | 4,225 | 107 | 545 | 3,219 | 131 |
| Spain | 10,565 | 355 | 3,308 | 6,346 | 166 |
| France | na | na | na | na | na |
| Ireland | 267 | 177 | 80 | 329 | 81 |
| Italy (95/96) | 13,845 | 1,432 | 3,993 | 10,010 | 138 |
| Netherlands (95/96) | 3,840 | 1,382 | 3,719 | 1,447 | 265 |
| Austria | 499 | 436 | 82 | 728 | 69 |
| Portugal | 1,986 | 169 | 744 | 1,244 | 160 |
| Finland | 247 | 112 | 8 | 315 | 78 |
| Sweden | 255 | 513 | 61 | 558 | 46 |
| United Kingdom (95/96) | 3,138 | 2,954 | 331 | 5,660 | 55 |

Source: Eurostat, na = not available.

Major producers of fruit (table 3.4) are France and Italy (figures for Spain are not available). In the Netherlands, the import of fresh fruit exceeds the export. The self-sufficiency rates are highest in France, Greece, the Netherlands and Italy. Production rates in these countries substantially exceed consumption. Net importers of fruit are Sweden, Ireland, United Kingdom and Germany. The Benelux countries (Belgium, the Netherlands and Luxembourg) are the main exporters of potatoes (table 3.5), while most countries are net importers. Although production is higher than consumption in most EU countries, they are still net importers, as a large share of potato production is not used for human consumption. Most countries also import seed potatoes. An interesting area but not incorporated in the tables above is viniculture. The EU accounts for about 45 per cent of the world area of vines, and about 60 per cent of world consumption and production. The EU also accounts for about 80 per cent of global exports in wine. Wine consumption in 1996 was 128 million hectolitre, with France, Italy and Spain accounting for more than 60 per cent of total EU-internal consumption.

*Table 3.4 Supply balance sheet fresh fruit, 1996/1997 (1,000 tonnes)*

| Country | Production | Import | Export | Consumption | Self-sufficiency rate (%) |
|---|---|---|---|---|---|
| Belgium/Luxembourg | 302 | 347 | 332 | 279 | 108 |
| Denmark | na | na | na | na | na |
| Germany | 788 | 727 | 49 | 1,308 | 60 |
| Greece (93/94) | 322 | 15 | 55 | 185 | 174 |
| Spain | na | na | na | na | na |
| France (95/96) | 2,089 | 218 | 936 | 1,144 | 183 |
| Ireland | 10 | 46 | 5 | 47 | 21 |
| Italy (95/96) | 1,885 | 85 | 607 | 1,263 | 149 |
| Netherlands (95/96) | 535 | 509 | 439 | 331 | 162 |
| Austria | 163 | 42 | 28 | 158 | 103 |
| Portugal | 231 | 67 | 13 | 270 | 86 |
| Finland | 2 | 71 | 8 | na | na |
| Sweden | 17 | 115 | 7 | 114 | 15 |
| United Kingdom (95/96) | 227 | 613 | 66 | 771 | 29 |

Source: Eurostat, na = not available.

*Table 3.5 Supply balance sheet potatoes, 1996/1997 (1,000t)*

| Country | Production | Import | Export | Consumption | Self-sufficiency rate (%) |
|---|---|---|---|---|---|
| Belgium/Luxembourg | 2,806 | 1,001 | 1,873 | 982 | 286 |
| Denmark | 1,455 | 240 | 116 | 300 | 485 |
| Germany | 12,473 | 1,355 | 1,495 | 6,011 | 208 |
| Greece | 920 | 240 | 25 | 985 | 93 |
| Spain | 3,710 | 539 | 185 | 3,355 | 111 |
| France | 6,249 | 1,208 | 1,147 | 3,372 | 185 |
| Ireland | 733 | 221 | 25 | 647 | 113 |
| Italy | 1,909 | 876 | 294 | 2,191 | 87 |
| Netherlands | 8,182 | 1,673 | 3,824 | 1,322 | 619 |
| Austria | 769 | 52 | 9 | 450 | 171 |
| Portugal | 1,326 | 298 | 30 | 1,371 | 97 |
| Finland | 766 | 36 | 25 | 395 | 194 |
| Sweden | 1,326 | 179 | 33 | 739 | 179 |
| United Kingdom | 7,225 | 1,095 | 336 | 6,306 | 115 |

Source: Eurostat.

*Consumer concerns*

European consumers are demanding higher quality products, more convenience products and more variety in food products (Grunert et al., 1996; Gordon, 1998). Consumers are increasingly concerned about issues like food safety and quality, environmental sustainability and ethically appropriate methods of production (animal welfare issues related to housing and transport of animals) (Blandford and Fulponi, 1999). As a result, governments in many industrialised countries are being asked to implement more stringent rules and regulation. Food processors and retailers also are responsive to consumer demands, and they increasingly pay attention to these consumer concerns. One of these concerns relates to the use of plant protection products in the production and storage of farm products. In the Netherlands, for instance, a survey among 15,000 consumers showed that plant protection products are their third most important concern in relation to food (Consumentengids, September 1999) [1].

Consumer concern regarding the safety and quality of food result from a combination of several trends. Increasing income and the subsequent decreasing part of income spent on food (The law of Engel) result in the purchase of more expensive food, with a wider variety and more convenience. For instance, as income rises people tend to consume less cereal products and potatoes and increase the expenses on fruit and vegetables. Higher income also offers the opportunity to become more critical about the quality [2] of the food they purchase. In addition, several recent food safety scares (BSE, dioxin, salmonella) have made consumers more aware of the health risk of food consumption. The use of plant protection products and particularly the presence of residues, is one of the issues that consumers are increasingly concerned about.

Improvements on the environmental profile of production methods applied are also receiving more attention from consumers. For instance, in the Netherlands, ever since the early 1990s, the problem of environmental pollution ranks high on the list of societal issues that consumer are concerned about (Van Raaij and Antonides, 1997). Both personal experience with pollution (bans on swimming in polluted rivers and canals, oil on the beach, etc.) and extensive media coverage of environmental problems have made consumers increasingly aware of the environmental effects related to production and consumption.

In assessing the quality of food products, environmental issues and food safety issues combine. Consumers have a negative perception of plant protection products, both because of (perceived) health effects of residues in food products and because of the (perceived) harmful environmental effects of the production and use of plant protection products. For a large part, the growth of organic production can be explained by the dual concern over the health and environmental impact of the use of plant protection products.

[1] Genetically modified food ranks first, and labelling second. The impact of environmental pollution on food came fourth.

[2] Product quality is a broad concept with diverse interpretations. While consumers are concerned about the presence of pesticide residues on fresh fruit and vegetables, they also demand products that have a spotless appearance.

Consumer concerns regarding quality and safety have become important issues in the marketing of food products. Depending on the particular market conditions, food processors and food retailers have incorporated consumer concerns in their marketing strategies, and have started to demand quality guarantees from their suppliers. In the following sections we will examine such initiatives taken by food processors and food retailers.

## 3.3 Responses by food processors and retailers

In response to consumer demands for environmentally friendly products and sustainable production methods, food processors and food retailers have started to scrutinise their supplies as well as their suppliers. Not only do they want their suppliers to abide to the legal requirements, but also some of them have designed their own schemes to enhance food quality. Multiple quality management schemes are being set up in the agrifood sector, some of them initiated by farmers themselves, others by food processors and retailers (see for instance Schiefer and Helbig, 1997). A reduction of on-farm use of plant protection products is one of the main elements in these quality schemes. Depending on whether the products are sold fresh or go through some stage of processing, the retailer or the food processor respectively is taking the lead in demanding raw materials and fresh products with an improved environmental profile. For some of these companies it is just a trend in the market they cannot ignore. Others, however, have made selling products with a better environmental profile a key element of their marketing strategy. The use of plant protection products is an important issue in the corporate effort to develop more environment friendly production methods. Food processors and retailers have started to collaborate with their suppliers and with agronomic research institutes, on the design and implementation of sustainable cultivation methods, which include reduced use of plant protection products. For example, the US based global food processor Campbell Soup Company has developed an Integrated Pest Management (IPM) programme in order to meet the consumer goal of reduced exposure to chemical plant protection agents (Anderson, 1999). Campbell is even developing its own tomato varieties that fit in a low-chemical plant protection cultivation practice.

*Food processors*

Food processing firms employ various strategies to maintain or improve the quality of the raw material they use in manufacturing food products. These include attribute or component pricing, production contracting of specific attribute raw materials, supplier partnering, and vertical integration (Connor and Schiek, 1997).

First, they can offer price premiums for raw material that has a more than proportional share of a desired component and/or a price discount for low levels of the component. Thus, suppliers are encouraged to deliver more of the desired attributes in their products. The essen-

tial criterion is that the purchasing firm has the technical capability to measure the component or attribute when they make the purchase.

Second, if attribute profile of raw material is affected by agricultural production practices, food processing firms can attempt to encourage their suppliers to use standard production systems, like Good Agricultural Practice (GAP). Particularly if processing efficiency depends on a uniform attribute profile, purchasing firms want all of their suppliers to use the same cultivation methods. Production contracts (or vertical contracts) are the mechanism used by purchasers to secure raw material with specific attributes. As part of such contracts, food processors may provide some of the key resources needed in the agricultural production process, like seeds and agrochemicals. When attributes cannot easily be measured at the point of purchase, food-processing firms are more likely to require their suppliers to utilise specific production practices. The use of plant protection products is one of such attributes.

A third strategy of guaranteeing the supply of desired raw material is supplier partnering. This strategy is increasingly used by food processors to develop better suppliers and assure a more reliable supply of high quality inputs. Important features of supplier partnering are the transmission of Total Quality Management (TQM) concepts and systems from the processor to the supplier, and the use of a system for classifying suppliers. Such a classification should include appropriate incentives to suppliers to achieve a transition towards a higher classification.

The fourth strategy for reducing quality-related input procurement risk is vertical integration. In a vertically integrated system, the food processor takes on the role of supplier either through the acquisition of a current supplier or the 'greenfield' establishment of a new subsidiary or division for the purpose of growing the required raw material. There are several quality-associated reasons for choosing a vertical integration strategy. Such strategies apply when inputs are highly specific to the needs of the firm; when monitoring or measuring purchased input quality is technically difficult; when product differentiation is obtained at supplier level; and when regulatory changes require a vertical control, for instance for quality guaranteeing.

*Retailers*

Retailers have followed similar strategies to guarantee the quality of the agricultural products they purchase. Of course, this is only useful for fresh produce, where no food processor is involved. Vertical contracts and supplier partnershipping is increasingly used by large retailers in their relationship with farmers, farmers' co-operatives and wholesalers. Retailers have also collectively developed quality requirements for their suppliers of fresh produce. The EUREP GAP Protocol, developed by 14 major European food retailers, is such an initiative.

In November 1999, 14 European food retailers [1] collaborating in the Euro-Retailer Produce Working Group (EUREP) introduced their Good Agricultural Practice (GAP) verification scheme (EUREP, 1999). The EUREP is a technical working group with the objective to encourage best agricultural practice by producers of fruit and vegetables. The establishment of EUREP and the introduction of the GAP protocol are a response to increasing consumer interests in food safety and environmental issues.

> 'The EUREP GAP Protocol sets out a framework for Good Agricultural Practice (GAP) on farms. It defines essential elements and develops best practice for the global production of horticultural products (e.g. fruits, vegetables, potatoes, salads, cut flowers and nursery stock). It defines the minimum standard acceptable to the leading retail groups in Europe, and will be used as a benchmark to assess current practice, and provide guidance for further development. EUREP GAP is a means of incorporating Integrated Pest Management (IPM) and Integrated Crop Management (ICM) practices within the framework of commercial agricultural production (EUREP, 1999:5).'

Reduction in the use of agrochemicals is a major goal in the EUREP GAP initiative. In the terms of reference it is stated that the EUREP wants to 'encourage adoption of commercially viable ICM schemes for fresh produce, which promote the minimisation of agrochemical inputs, within Europe and world wide' (EUREP, 1999:8). The introduction to the Protocol itself states that all growers must demonstrate that they are committed to reducing the use of agrochemicals (EUREP, 1999:18). The introduction also stresses the importance of IPM/ICM cultivation methods, by stating that EUREP members regard the adoption of IPM/ICM as essential for the long-term improvement and sustainability of agricultural production. The plant protection part of the Protocol starts with the following basic elements:

> '(1) Protection of crops against pests, diseases and weeds must be achieved with the appropriate minimum pesticide input and with minimum adverse environmental impact (volume/type of active ingredients) and with the appropriate employment of non-chemical methods (biological and cultural/mechanical). (2) Wherever possible growers must apply recognised IPM techniques on a curative basis. Non-chemical pest treatments are preferred over chemical treatments (EUREP, 1999:23/24).'

Other instructions on plant protection include the choice of chemicals, records of application, methods of application, chemical plant protection residue analysis, and storage of plant protection products.

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[1] Safeway (UK), Sainsbury (UK), Tesco (UK), Waitrose (UK), Albert Heijn (NL), KF (Sweden), ICA (Sweden), Delhaize (B), GB (B), Promodès (F), Continent (F), Coop (I), Spar (AU), Kesko (F). Also member is the Belgian 'Dienst voor Residucontrole'. In June 2000, Laurus - the second largest retailer in the Netherlands - announced that it will join the EUREP group.

As to the use of agrochemicals, a weak point in the EUREP-GAP rules is differentiation that can exist in national registration of plant protection products. A particular product may be approved for usage in country B, but may not be approved or may be more restricted in use in country B because of the vulnerability of the environment in country B. This may result in ambiguous information for consumers, because fruit and vegetables from different cultivation schemes may be sold under the same EUREP GAP 'label'. Some producers have complained that this is 'unfair' competition for the growers from the country with the more restrictive registration policy (Oogst, 19/11/99). Whether it really is unfair competition depends on how the EUREP GAP requirements are communicated to the consumer.

The EUREP GAP Protocol may have several implications for the European fresh produce market. First, food retailers involved in this initiative exclude basic quality characteristics of the fresh produce they sell from competition. Second, the initiative will pressure other retailers to apply the same requirements for their suppliers. Third, more and more farmers will eventually adopt these guidelines, if they want to (continue to) supply major retailers. In fact, the EUREP GAP criteria have the potential to become a minimum standard in the market for fresh produce. Fourth, also non-European suppliers will have to play by the same rules, thus broadening the scope of application of the Protocol. Fifth, it leads to the development of independent verification agencies, working on a European-wide scale.

The active role of food processors and food retailers in enhancing and monitoring the quality of food products cannot be understood without looking at structural changes taking place within the agrifood sector as a whole. Increasing scale of operation, internationalisation, concentration, vertical co-ordination, and increased competition are some of the dynamics taking place in this sector. It is towards these structural changes that we now turn.

## 3.4 Structural changes in the agrifood chain

Major structural changes in the European agrifood sector are concentration at various stages of the production and distribution chain, internationalisation of food production and food retailing, the market share growth of private label products, and increased collaboration among firms from various stages of the agrifood chain. The latter trend is better known as vertical co-ordination.

*Concentration and internationalisation*

In the 1990s, concentration among retailers has increased in most European countries (ISMEA, 1999). However, concentration ratios in food retailing continue to be divers. Table 3.6 presents the 1995 markets shares of the top 5 food retailers by country. It shows that concentration is highest in the Northern European countries. Since 1995, consolidation processes among retailers have continued. For instance, in the 1998, the four largest food retailers and purchase groups in the Netherlands had a combined market share of 82 per cent (NRC Han-

delsblad, 17/7/99). Reasons for consolidation in food retail are the building of strong negotiating position vis-à-vis suppliers, and obtaining sufficient scale for private label products and investments in advertising and information technologies. Mature market conditions means that mergers and take-overs can only reach growth. Also, increasing internationalisation (or globalisation) forces firms to broaden their scale of operation.

The largest European food retailers can be found in France, Germany and the United Kingdom. A large home market has greatly facilitated the growth of domestic companies. Table 3.7 gives the ten largest food retailers in Europe in 1996. Since then, further consolidation has taken place. For instance, the acquisition of Promodès by Carrefour, making the latter the largest European food retailer, with a turnover (in Europe) of 47 billion Euro in 1999. Since its 1998 acquisition of German retailer Wertkauf and the 1999 acquisition of the UK retailer Asda, USA based Wal-Mart is also present in Europe. Wal-Mart is the largest retailer in the world, and takes the tenth position in the list of largest European food retailers. Netherlands based retailer Ahold is also among the largest European retailers but is in the top ten because it generates approximately 65 per cent of its turnover outside of Europe, particularly in North and South America.

*Table 3.6 Market share of top 5 retailer (1995)*

| Country | Market share top 5 retailers (%) |
|---|---|
| Norway | 92 |
| Sweden | 84 |
| Finland | 84 |
| Luxembourg | 75 |
| Denmark | 72 |
| Belgium | 67 |
| Portugal | 67 |
| Switzerland | 62 |
| Germany | 61 |
| France | 58 |
| Austria | 57 |
| United Kingdom | 51 |
| Ireland | 51 |
| Netherlands | 50 |
| Spain | 47 |
| Greece | 33 |
| Italy | 15 |

Source: Baas et al., 1998:48.

*Table 3.7 Ten largest European retailers (1996, billion USD)*

| Company | Country | European Sales |
|---|---|---|
| Intermarché | France | 26.3 |
| Rewe | Germany | 25.0 |
| Aldi | Germany | 22.8 |
| Metro/Makro | Germany | 22.4 |
| Promodès | France | 21.1 |
| Edeka/AVA | Germany | 20.7 |
| Auchan | France | 20.3 |
| Tesco | United Kingdom | 16.9 |
| Sainsbury | United Kingdom | 14.7 |
| Carrefour | France | 14.4 |

Sources: Baas et al., 1998, p. 26.

European food retailing is also becoming more internationalised. Large supermarket chains from France, UK, Germany and the Netherlands have been acquiring other retail firms, particularly in Eastern Europe and on the Iberian peninsula, but also in North and South America. In 1998, Metro obtained 32 per cent of its turnover outside of Germany, and Carrefour/Promodès made some 40 per cent of its sales outside of France (Zuivelzicht, 10/5/00). Others like Rewe (Germany), Tesco (UK), Auchan (France), Sainsbury (UK) and Ahold (the Netherlands) also have foreign subsidiaries.

Another element of internationalisation is the collaboration of retailers in international purchase organisations, like EMD (11 per cent of the European food market), AMS (10 per cent), Eurogroup (5 per cent), NAF (5 per cent) and Agenor (4 per cent) (Zuivelzicht, 10/5/00). These alliances have increased the purchasing power of retailers vis-à-vis producers, for instance by eliminating large differences in producer pricing between countries.

Despite the general move towards concentration, there are significant differences in retailing in the various European countries (Gordon, 1998). While in the UK the top five are all multiples who own their outlets, in other European countries some of the top retailers are franchise companies (or combinations with own stores and franchise stores). Owning all the outlets gives more opportunity to impose uniformity and system throughout the whole store network. In addition, the UK type of concentration (with control over logistics and store configuration) is more constraining for the brand-name food and drink producers than the French or German 'systems'. German retailing, with competition primarily on prices, seems to be less advanced in terms of control over the supply chain than UK retailing (Gordon, 1998).

The growing concentration and power of modern retail is the number one preoccupation of all the major food producers (Gordon, 1998). The balance of power between producers and retailer is now firmly in the hands of the latter. The manifestations are imposition of trading terms - pricing, rebates, credit, special payments for access to retailers' shelves - and de-listing

if a supplier does not meet the trading terms or the retailer decides to limit the range of producer brands which are referenced. Concentration and internationalisation also takes place among food manufacturers, although large differences exist between sectors. If we only look at sectors processing plant products, the sugar industry is the most concentrated, while fruit and vegetable processing industry is the least concentrated (Traill, 1998). However, even the vegetable processing industry consists of several multinational companies, like Unilever (UK/NL) and Bonduelle (F). Consolidation is not the only response of large food manufacturers to the above described concentration among retailers (Traill, 1998). Also, they have seized the opportunities offered by the European market integration to develop European as opposed to national brands. In addition, manufacturers are searching for plants flexible enough to supply the wide product range demanded by fragmented consumer markets. Or they are reorganising production into large plants capable of supplying the entire European market in certain product categories. Finally, they are seeking new products based on new technologies.

*Vertical co-ordination*

There is increasing collaboration and co-ordination among companies participating in a vertical agrifood chain. Reasons for vertical co-ordination (sometimes called vertical integration) lie in (1) enhancing the efficiency in the whole production, processing and distribution chain, and in (2) guaranteeing safety and quality through the whole chain. Particularly for fresh food products, the quality of the final product is strongly influenced by the choice of starting material (e.g., seeds), by the cultivation method used, by the storage and transportation conditions, and by the total time spent on all these activities together. More vertical co-ordination has made all parties in the agrifood chain more aware of and sometimes even more knowledgeable on the activities carried out at other stages of the chain. Thus, vertical information exchange has also increased among producers, processors and retailers. Retailers provide their suppliers with more detailed information on food purchases, while farmers give more detailed information on cultivation methods. An increasing number of farmers are keeping records of all on-farm activities, like crop variety choice, use of plant protection products (date and method of application, product used, quantity of product applied, etc), fertiliser use, irrigation, and date of sowing and harvesting.

*Private labels*

A significant part of all food products are sold under private label. Still, the share of private label products varies from country to country and from chain to chain (table 3.8). Anecdotal evidence shows the percentage of products sold under private label is now even higher than the figures presented in table 3.8. The UK has been front runner in this development, but other countries are catching up. Private labels are still embryonic in Italy and Spain, due to the much lower degree of sophistication or integration of the major retailers. It is expected that this will

change in the coming years, particularly in Spain and Portugal, as large foreign retailers are rapidly taking over domestic firms.

*Table 3.8 Market share of private label products (1995)*

| Country | Private label products (% of total sales) |
|---|---|
| UK | 55 |
| Switzerland | 35 |
| Belgium | 25 |
| Germany | 20 |
| Netherlands | 15 |
| France | 15 |
| Italy | 5 |

Source: Baas et al., 1998, p. 44.

Private label products play an important role in increasing margins and creating company images. While in the early years of private labels the products offered were often generics, low-priced alternatives to branded products. Nowadays private label products often compete on quality with A-brands, but are still offered for lower prices. Private labels have become important profit generators. According to Hughes (1996), UK retailers have earned a higher level of net profits as percentage of sales compared to retailers in other EU countries and the USA, due to a combination of relatively high retail concentration, centralised purchasing, and strong premium own label presence.

In Germany, private labels have a different position compared with other European countries. Here, own brands basically play the role of financial alternatives for the A-brands. A large discounter like Aldi sells all of its products under private label. As Aldi has expanded into the Netherlands, Belgium, France and the UK, it has influenced the position of other retailers towards discounting. Mainline retailers have counter-attacked by developing a special discounted range of products (e.g., 'Euroshopper'), or by setting up hard discount formula themselves.

*Fresh produce*

Another important development in food retailing is that the supermarket share of total fruit and vegetables purchases is growing at the expense of speciality shops. In 1997, the supermarket share of fruit and vegetable retailing was almost 70 per cent for France. By that time it also exceeded 60 per cent in the Netherlands, the UK, Germany and Belgium (table 3.9). In the Scandinavian countries, more than 80 per cent of all fresh produce is purchased through the supermarket (OECD, 1997). In France, consumers continue to visit markets, where one fifth of

all fresh produce is purchased. Fresh produce is of strategic importance for the large food retailers. Particularly in the UK, but also in other European countries, supermarkets compete with their image of being a supplier of quality produce (Hughes, 1996). Research in Denmark has shown that the fruit and vegetables department provide good opportunities for strengthening store identity and customer loyalty, which are important because of the increasing competition among retailers (Bech-Larsen, 2000).

*Table 3.9 Share of purchase channels for fresh produce in 1997 (volume)*

| Country | Supermarket | Speciality shop | Markets and others |
|---|---|---|---|
| Netherlands a) | 64 | 16 | 20 |
| France | 69 | 7 | 23 |
| UK b) | 62 | 31 | 7 |
| Germany | 65 | 20 | 15 |
| Belgium | 64 | 13 | 23 |

a) 1999; b) Share of total households choosing purchase channel
Sources: various.

Sales under private label products, particularly for fresh produce, also bring a risk for the retailer. If quality problems are observed in a private label product or in case the quality performance of products varies over time, they can negatively affect all sales under this label, and may even discredit the image of the whole store. Therefore, a retailer selling (fresh) products under private label has a strong incentive to control product quality. Two developments lead to an extension of this quality control effort backward into the supply chain: food safety legislation and consumer concerns about production processes applied. Since the UK introduced the 1990 Food Safety Act, with its 'due diligence defence', retailers are required to do all that is reasonably possible to ensure that their own-branded products are safe (Henson and Northern, 1998). More recently, consumer concerns about the environmental-friendliness of cultivation methods have induced retailers to set requirements for production processes (particularly for fresh produce). As a result, major food retailers have implemented systems to control the quality and safety of private label products throughout the supply chain, involving end-product testing and surveillance and audits of new and existing suppliers against pre-specified standards. This development has also strengthened the trend among retailers to limit the number of suppliers.

We can conclude from this overview that European food retailing has become much more concentrated, giving the large retailers market power vis-à-vis their suppliers. Still, major differences exist among European retailers, in scale, in competition strategy, in internationalisation and in control over the supply chain. For most retailers, fresh produce is an important product category. In reaction to consumer concerns and to the vulnerability of their

private label products, retailers are looking for mechanisms to guarantee the quality of the fresh produce. Large retailers take the initiative to set up quality control systems and implement a system of cultivation requirements to which supplying farmers have to comply. Record keeping and information exchange is a major prerequisite for the collaborative effort to reduce harmful environmental effects of cultivation methods. A reduction in the use of plant protection products is one of the goals in ICM schemes developed by or in collaboration with retailers. UK firms and continental firms with a strong quality orientation seem to be more advanced in requiring specified cultivation methods, including a reduced use of plant protection products. In the remaining part of this chapter we will discuss in more detail some of the initiatives taken by retailers and food processors to change farming practices and identify the role of plant protection products in achieving such strategies.

## 3.5 The Netherlands

*Sustainable food production*

The Dutch Foundation for Sustainable Food Production (DuVo - Duurzame Voeding), set up in 1995, is a collaboration of 15 food processing companies [1] with the aim of promoting sustainability throughout the production and distribution chain of food products (Stichting DuVo, 1999). The activities of DuVo are (1) to increase our understanding on the production and distribution of sustainable food products, (2) to exchange information on individual experiences that contribute to such goals, and (3) to initiate a dialogue among actors involved. Under the objective of enhancing knowledge, DuVo has initiated research into the sustainability of various activities in the food production and distribution chain. One of the outcomes was the acknowledgement that the agricultural production phase of the chain has the largest environmental impact. For the exchange of experiences, DuVo members have chosen five environmental issues: waste, energy, plant protection, nutrients and water. A large number of DuVo members seek to reduce the use of chemical plant protection agents. DuVo members have established various programmes of controlled or registered cultivation. Their objectives are to keep records on usage of plant protection products and to contribute to a reduction of the use of plant protection products (Stichting DuVo, 1999, p. 9). For instance, HAK, a producer of premium branded fruit and vegetables preserves, has implemented an integrated crop management system for all its Dutch contract growers. This ICM programme includes guidelines for use of plant protection products. In recent years, HAK growers have achieved a reduction in the use of chemical plant protection by 55 per cent on average, and HAK expects this figure to rise to 70 per cent in 2000 (Stichting DuVo, 1999, p. 27).

[1] Participating companies are Albert Heijn, Avebe, CSM, Cebeco Group, Cehave, Campina Melkunie, DSM, Heineken, McDonald's, Van Melle, Numico, Sara Lee/DE, Cosun, The Greenery International and Unilever.

In May 2000, the interest organisation for food retailers, CBL, has stated that farmers should no longer use particular plant protection products (AgD, 20/5/00). As of January 1, 2000, 36 plant protection products no longer have a registration in the Netherlands, because they do not fulfil the legal requirements. However, at a request from agricultural producers, nine of these products have obtained the temporary legal status of being indispensable for agricultural and horticultural production. This applies particularly for so-called minor crops (i.e., crops that are only grown in small quantities, and for which registration of plant protection products is often not cost efficient). Environmental organisations do not agree with this status of being indispensable, as they consider these products too harmful for the natural environment. In Spring 2000, the main Dutch environmental NGO - the Stichting Natuur en Milieu - has approached CBL with the request to have its members refuse foods produced with the nine indispensable plant protection products. CBL has responded positively to this request, because the organisation on principle objects to all chemical plant protection products.

This trend of retailers (and perhaps also food producers) to respond directly to requests from environmental organisations on the issue of plant protection is an interesting development. It implies that environmental organisations are shifting their efforts from influencing the public debate and public authorities towards food producers and food retailers. As such, it reinforces the trend, described above, of (large) food companies and retailers setting strict cultivation requirements for their suppliers. We will now turn to two examples of this development.

*Albert Heijn*

Albert Heijn (AH) is the largest food retailer in the Netherlands, with more than 680 stores and a market share of 27 per cent. AH is part of the Ahold company, which has supermarket chains in other European countries as well as in North and South America and Asia. With one third of all its products sold under private label, AH has the highest share of own-branding in the Netherlands. AH's focuses on the middle and higher income market, and considers fresh products as a strategically important product category.

In 1990, AH started with an Integrated Crop Management (ICM) programme (Ahold, 1998, 2000). Albert Heijn has developed, together with the Dutch Centre for Agriculture and Environment (CLM) [1], standards for Dutch growers to ensure gradual improvements regarding the environmental impact of agricultural production. The programme, named Earth & Values, is Albert Heijn's private ICM programme. Besides environmental impact, it also addresses social/economic elements. One of the main goals is to reduce the use of agrochemicals in the production of fruit, vegetables and potatoes.

Government policy to reduce the use of chemical plant protection, as announced in the 1991 Multi-Year Crop Protection Plan (MJPG), has been the reason for AH to start its own

[1] The Centre for Agriculture and Environment (CLM) is a non-profit foundation aimed at promoting sustainable agriculture with an extended function. Farmers and growers work closely with conservationists and environmentalists, both on the CLM board and in various projects (htttp://www.clm.nl).

chemical plant protection reduction plan. Under the ICM programme, a combination of technical, natural and common sense techniques are used to reduce the use of plant protection products and chemical fertilisers. Participating growers are obliged to keep records of all cultivation activities regarding the use of plant protection products, fertilisers, spraying equipment, crop varieties, etc. The programme also includes the prohibition of the use of aeroplanes for spraying and the use of soil disinfection. Heavily polluting substances, even if they are legally registered, are not allowed under this scheme.

According an AH spokesman [1], requirements for use of chemical plant protection concern the use of specified products, the amount of active ingredients used, and the method of application. While in the first half of the 1990s the emphasis was on reducing the amount of plant protection products used, in later years the kind of product used has received more attention. For deciding which plant protection products are allowed within the ICM programme, the environmental yardstick developed by the CLM is used. Requirements for fresh produce production are similar to the environmental criteria used by EUREP (see above) and those used by the Stichting Milieukeur. The Stichting Milieukeur issues a certificate for low environmental impact of agricultural products (and also for non-food products) [2]. This environmental certificate (in Dutch: milieukeur) indicates that the production and distribution of the particular product has a lower environmental impact than similar but non-certified products.

Initially a small number of growers started with AH's ICM scheme, on a limited number of crops. Over the years, both the number of crops and the number of participating suppliers has increased, and by January 2000 almost all fruit and vegetables sold by Albert Heijn is produced under its ICM programme (Albert Heijn, 2000). Given that AH has a market share in food retailing of about 27 per cent, we can conclude that at least one fifth of all fresh produce consumed in the Netherlands is produced under AH's ICM rules.

In 1997, AH extended its ICM programme to its foreign suppliers, particularly in Spain, France, Israel and Italy. It is Albert Heijn's final aim to sell only fresh produce from either ICM or organic cultivation practices (Van der Grijp and Den Hond, 1999). In 1996, the ICM programme was evaluated by the CLM, which concluded that the environmental impact of cultivation showed annual improvements during the period 1992 - 1996 (Ahold, 1998).

According to Stichting DuVo (1999), the Earth & Values programme has resulted in a more than 50 per cent reduction in the use of chemical plant protection in cultivation of vegetables, fruit and potatoes. Specific environmental benefits that have been obtained through their ICM programme have not been made public. Only in Ahold (2000), some results of the international application of the Earth & Values programme are presented:

> 'In Italy, cauliflower, broccoli, peaches, kiwi and strawberries are grown without herbicides. The use of plant protection products in tomato production at Albert Heijn's preferred supplier in Spain have been reduced dramatically. In the Netherlands, spring

[1] Telephone conversation between Jos Bijman (LEI) and Willem Hofmans (AH), on 17 May 2000.
[2] See: www.milieukeur.nl/english/food.php.

onion growers have successfully interrupted the reproductive cycle of the onions fly by introducing sterile males. This means that spraying against this pest is only required in exceptional circumstances (p. 12).'

In April 1999, AH made an announcement that by the year 2000 it only wants to sell fruits and vegetables that have been produced without chemical herbicides [1]. Interestingly, environmental impact and sustainability are no longer the key drivers behind these initiatives of AH. Consumer health has become the main focus of attention:

'We will focus even more than in the past on consumer demands. The consumer currently is more concerned about human health than about the environment. Therefore our goal is to sell residue-free products (Simone Hertzberger, Head of the Quality Department of AH, in: Agrarisch Dagblad, 12 October 2000; our translation FB/JB).'

AH is currently investigating the achievability of this goal, for instance by collaborating with its potato suppliers in doing experimental studies for herbicide-free cultivation methods (Aardappelwereld, February 2000). As AH wants to be one of the front runners in responding to consumer demands, AH is continuously evaluating the criteria in its Earth & Value programme, and will tighten these if needed and possible [2].

*Natural sprout inhibitor for potatoes stored for processing*

While consumers want to purchase potatoes and potato products all year round, cultivation of potatoes is a seasonal activity. Storage of potatoes for a period up to one year is possible under low temperature suppressing and delaying the natural sprouting process. However, for the potato processing industry cold storage has disadvantages. In low temperature, potatoes form reduced sugars, which result in black spots when the potatoes are fried. For this reason, potatoes for the processing industry are stored under temperate conditions, and the sprouting process is suppressed by applying chemical sprout inhibitors, usually propham (IPC) or chlorpropham (CIPC).

Potato processors are increasingly concerned about the use of these chemical sprout inhibitors. In some Scandinavian countries the use if IPC and CIPC has been forbidden for several years, while Denmark has prohibited the use of these chemicals as of the fall of 1999

[1] A statement by Mr. W. Hofmans, working for the Quality Department of AH, during a workshop on chemical weed control, 1/4/99, in Wageningen.

[2] Besides the products cultivated under ICM standards, AH sells an increasing number and amount of organic food products. As recently as 1998, Albert Heijn has decided to offer its customers a broad range of organic food products, most of them sold under private label (Albert Heijn, 1999). The reason for AH to promote organic food is that the company (1) wants to be innovative, (2) wants to respond to consumer demands for healthy and tasty food, produced with care for humans, animals and the environment, and (3) follows a strategy of expanding its assortment of high quality fresh produce.

(AgD, 15/12/99). In response to consumer concerns about the use of chemicals in food production, potato processors have started looking for alternatives. In addition, also retailers selling potatoes and potato products are seeking ways to avoid the use of post-harvest chemicals (e.g., Sainsbury's in the UK). LEI data show that the total amount of sprout inhibitors used in the Netherlands has decreased in the 1990s. While in 1990 still 72,000 kg of active ingredient was used, in 1998 it was reduced to 33,000 kg, for the same volume of potatoes stored.

Another way to reduce the use of chemical sprout inhibitors is the development of non-chemical alternatives. The Agrotechnological institute (ATO) in Wageningen (The Netherlands) has developed such an alternative. The active ingredient of this natural sprout inhibitor is carvone that is extracted from caraway seed oil. Luxan, a subsidiary of Cebeco Group, has developed it into a commercial product. Under the brand name 'Talent', Luxan has been marketing the natural anti-sprouting device in the Netherlands and Switzerland since 1996. The product is currently in the process of registration in other EU countries (Agrow, 17 March 2000). The development of Talent has been quite costly. However, the potato processing industry in the Netherlands has encouraged Luxan to develop this product. Cebeco Group, the owner of Luxan, is also majority shareholder in the largest potato processor of the Netherlands, Aviko. Cebeco Group has also supported Luxan in developing Talent. In the Netherlands, Talent has obtained a market share of 6 per cent on 1998.

Talent has some additional attractive characteristics (Hak, 2000). First, it can also be used for storing and transporting seed potatoes. As it does not kill the sprouting vigour but it only suppresses it, sprouting starts again once the product is no longer effective. Second, it also suppresses the growth of fungi (like silver scurf and dry rot) on stored potatoes. Third, it can be used for storing organic potatoes to be processed into potato products.

## 3.6 United Kingdom

*Food retailing*

Food retailing in the UK is rather concentrated, although not as concentrated as France and Germany. In 1996, the four largest grocery retailers (Tesco, Sainsbury's, Safeway and Asda) had a combined market share of over 40 per cent (Henson and Northern, 1998:114). According to another source, the big four even had a market share of 52 per cent (Harvey, 2000). Tesco, the largest UK retailer, has a turnover of about 30 billion Euro. In 1999 the world's largest retailer, the American Wal-Mart, acquired Asda.

*Table 3.10 UK retailers: market share and own-brand sales*

| Retailer | 1996 Share of Retail Grocery Market (%) | 1995 Own Brand Share of Packaged Grocery Sales (%) |
|---|---|---|
| Tesco | 14.2 | 45.2 |
| Sainsbury's | 12.3 | 53.4 |
| Safeway | 7.7 | 41.2 |
| Asda | 7.7 | 38.6 |
| Somerfield | 4.2 | 38.5 |
| Kwik Save | 4.3 | 11.7 |
| Marks & Spencer | 3.3 | 100.0 |
| Morrisons | 2.5 | 32.0 |
| Waitrose | 1.8 | 37.4 |
| Iceland | 1.6 | 54.1 |

Source: Henson and Northern, 1998.

A key component of the growth strategies adopted by many of the major multiple food retailers is own-branding (table 3.10). The market penetration of private label food products increased significantly through the 1980s and early 1990s, to reach 37.6 per cent of retail grocery sales in 1995 (Henson and Northern, 1998:114). Own-branded products have been seen as strategically important for two reasons: they have proved to be a highly effective mechanism for generating customer loyalty, and there is evidence of a strong relationship between net margins and the proportion own brand products in total sales (Hughes, 1996). Fresh and freshly prepared, chilled products are almost exclusively sold under private label, as no manufacturer brands existed in these product categories. Another interesting feature of private label products, at least in the UK, is the involvement of the retailer in product innovation (Harvey, 2000). Own-brands now account for 62 per cent of new product launches.

A high level of private label produce is not the only consequence of the centralisation of buying power in the UK. Market power has also been used for re-organising the supply chain for produce. Instead of an industry where producers and suppliers were sharply separated from retailers, the new organisation of the industry is characterised by the integrated supply chain (Harvey, 2000). Nowadays, the major UK multiples have dedicated long-term supply relationships with producers of fresh and chilled product, giving them substantial influence over the organisation of production and distribution. One of the front runners in private label development and integrated supply chain management is Sainsbury's.

*Sainsbury's*

Sainsbury's is the second largest supermarket chain in the UK. It is committed to reducing the impact of its operations on the environment, including the operations in the supply chain. For

the agricultural products it sells, Sainsbury's is actively promoting Integrated Crop Management (ICM) systems. Sainsbury's has asked its suppliers to use the LEAF Audit [1] when adopting the ICM programme. Sainsbury's is also a member of the EUREP group.

Within Sainbury's ICM system, chemical plant protection is used only when necessary and is targeted against specific pests or diseases with localised treatments where possible. In 1997, 88 per cent of produce originates from the UK and 57 per cent of overseas produce were grown under ICM protocols. In March 2000, a press release stated that all of Sainsbury's UK fruit and vegetables are grown according to ICM protocols. On its web-site, Sainsbury's makes the following statement on agricultural practice and use of chemical plant protection products:

> 'Sainsbury's supermarkets is committed to the safe, efficient and environmentally responsible production of foodstuffs. We aim to achieve this through developing 'best practice' systems, recommending the long-term reduction of agrochemical inputs, while continuing to maintain quality. Sainsbury's supermarkets operate targeted pesticide surveillance to monitor the safety and quality of products sold in our stores. This programme is directed by our technologists through pro-active identification of pesticide residue test results, and visits to our suppliers in the UK and overseas. Where current technology allows, we identify products where the application of post-harvest chemicals can be avoided.' (Source: www.j-sainsbury.co.uk/environment/pr/index.htm; visited 28/4/00)

Sainsbury's has a special co-operation programme with its suppliers of fresh produce, under the name of Partnership in Produce (Hughes and Merton, 1996). Fresh produce - all sold under private label - is of strategic importance for Sainsbury's, as it can contribute to store loyalty, gross sales and profitability. To take advantage of the opportunities fresh food products offer but also to deal with the risks that fresh produce brings, Sainsbury's has started vertical partnerships with its supply chain partners.

In 1995, it started with an agreement with ENFRU Ltd (The English Fruit Company), an apple and pear marketing co-operative that is the principal supplier of top fruit to the UK retail trade. ENFRU farmers, as well as other suppliers who joined the Partnership later, agree to work to mutually agreed crop protocols, which state best practice for crop production and environmental concerns through the above mentioned ICM system. Minimising chemical usage in pest control is part of this system. The partnership also extends to research, and Sainbury's technologists visit suppliers to discuss all aspects of production. This also leads to investment and research on produce varieties, storage techniques and production facilities.

[1] LEAF (Linking Environment And Farming) is a UK initiative to develop and promote Integrated Crop Management (ICM). LEAF aims to encourage farmers throughout the UK to take up ICM through the production of practical guidelines on ICM and the promotion of the LEAF Audit, and to promote the benefits of ICM to a wide range of interest groups and raise awareness of the way farmers are responding to current concerns. LEAF is a broad initiative, involving farmers, food processors, retailers, government bodies, consumers, scientists, environmental groups and crop protection industries (more information: www.leafuk.org).

*Unilever*

Unilever is a major producer of branded food products based on agricultural raw materials like tea, vegetable oils and vegetables. Agriculture provides more than two-thirds of the raw material for Unilever's products. Worldwide, Unilever is a major purchaser of black tea (15 per cent of world production volume), tomatoes (5 per cent), palm oil (6 per cent), peas (13 per cent) and spinach (28 per cent). In Europe, vegetables such as spinach and peas are the main agricultural raw materials for frozen branded foods. Unilever uses 3 types of suppliers: some products are purchased on the world market, some products are contracted from specific growers, and some products it produces itself. A direct relationship with suppliers gives Unilever influence on how the materials are produced.

In response to worries about the negative impact of agricultural production on the natural environment, Unilever has started, in the mid-1990s, its Sustainable Agriculture Initiative. The aim of this programme is to ensure continued access for Unilever to key agricultural raw materials, and in the long run, to develop market mechanisms that allow consumers and customers to influence the sourcing of agricultural raw materials through their buying habits. In the words of Unilever:

> 'Sustainable agriculture is productive, competitive and efficient while at the same time protecting and improving the natural environment and conditions of the local communities.' (Unilever, Growing for the Future, p. 9)

For many years, Unilever has been involved in the development of agricultural best practices for the above-mentioned crops, mainly based on integrated farming principles.

> 'Developing sustainable agricultural practices is (...) an essential element in the long-term health and prosperity of our business. We have initiated projects to increase our understanding in this area and to gain practical experience in methods of sustainable agriculture. We are also working with farmers to encourage them to adopt standards aimed at reducing environmental impact and we are seeking ways to provide better consumer information about how the ingredients in our products are grown.' (Environment Report 1998: inside front cover)

The development of sustainable agriculture standards is done in close collaboration with growers and other stakeholders. Unilever started from its Agricultural Best Practice guidelines, and will extend them to cover Integrated Crop Management (ICM) and Integrated Pest Management (IPM) principles. From there on, the company is working towards sustainable agriculture standards. Agreeing on indicators is a first major step in establishing criteria for sustainable agriculture. One of the ten sustainable agriculture indicators is pest management.

'A small but significant proportion of pesticides used on crops and livestock can escape to the environment, harming wildlife and accumulating in foods. Sustainable agricultural practices can substitute natural controls for some pesticides, so reducing dependence on externally introduced substances.' (Unilever, Growing for the Future, p. 11)

In 1997, Birds Eye Wall's (BEW), a UK Unilever subsidiary producing frozen foods, started a Sustainable Agriculture Project with its pea growers [1]. The goal of the project is to study the environmental impact of pea growing. Elements studied in this Partnership for Sustainability programme include plant protection, crop rotation, soil condition and energy use. Since 1999, the project has been shared with all 500 contracted pea growers. On the issue of the use of chemical plant protection, the programme, which builds on 50 years of experience in applied agronomic research at the Unilever Crop Science Department in Colworth, has lead to a substantial reduction in the use of plant protection products in pea cultivation. Compared to conventional pea production, pea growers supplying to BEW only use one third of total amount of chemicals. Another achievement of the programme is the substitution of rather polluting compounds for less polluting active ingredients. BEW pea growers are only allowed to use products specified in a list of preferred plant protection products for use on peas. This list contains about 10 to 12 products that have been selected on the basis of their score on a kind of environmental yardstick, developed by Unilever. These 10 to 12 products are a selection out of the approximately 40 officially allowed products. Moreover, regular meetings with the producers of chemical plant protection products have lead to the development of new and more benign products.

In its Partnership for Sustainability programme, BEW is collaborating with many organisations, representing various stakeholders: Forum for the Future, ADAS, Soil Survey and Land Research Centre, Environment Agency, the Wildlife Trusts, British Trust for Ornithology, Centre for Agriculture and Environment (CLM), and the University of Essex. Given the experimental character of the sustainability programme, these organisations can provide required expertise, can give scientific and political endorsement, and can use the experiences gained in this programme in their core activities.

## 3.7 France

*The FARRE Initiative*

Similar to the UK LEAF initiative, farmers, food companies and retailers in France have established the FARRE programme, in order to promote integrated farming. FARRE stands for Forum de l'Agriculture Raisonnée Respecteuse de l'Environment. Agriculture raisonnée is a

[1] Most of the information on BEW's sustainable agriculture programme was supplied by the project leader, Jos van Oostrum, in a telephone conversation with Jos Bijman, 13 June 2000.

special form of integrated farming (ICM), which combines three key criteria: financial objectives of farmers, demands by consumers and care for the environment. Besides exchanging experiences among the participants itself, FARRE also aims at communicating with the non-farming community about the benefits of integrated farming. All participating farmers have to sign the FARRE Charter, which includes requirements for low environmental impact of cultivation practices. Food processors and food retailers participating in the FARRE project include Auchan Carrefour and Danone. Also the agrochemical industry is involved, as it supplies most of the funds for the FARRE project [1].

Farmers participating in the FARRE project have to minimise the use of chemical plant protection products by taking precautionary measures, by monitoring developments of pests and diseases, by evaluating current and future damages, and by taking appropriate measures with a balanced mixture of chemical and non-chemical pest control methods. Products of agriculture raisonnée carry a special label and receive a higher price (about 10 per cent) than conventional products.

*Carrefour*

Carrefour is the largest retailer in Europe and Latin America and the first international retailer in Asia. The group has 680 hypermarkets, 2,260 supermarkets and 5,400 discount and convenience stores. After the 1999 acquisition of Promodès, the group expects to achieve consolidated sales of above 60 billion Euro in 2000.

Since 1991, Carrefour has a special programme for its suppliers of (fresh) food products called Filières Qualité Carrefour (FQC). With this programme, Carrefour seeks to preserve the good taste of food products, guarantee safe and healthy products, respect the production environment and maintain regional agricultural activities. The programme is based on a collaborative effort between farmers, food processors and Carrefour. The requirements for producers are written down, and collaborating suppliers have to sign a contract with Carrefour. Protection of the environment is a major element, and this is being obtained by promoting cultivation methods that need low chemical plant protection:

> 'Carrefour poursuit son engagement en faveur d'un agriculture propre, axée sur la préservation des terroirs et de l'environment, en encourageant les méthodes de culture qui permettent de limiter l'usage des traitements phytosanitaire au profit de pratiques alternatives naturelles et plus durables (Carrefour Press Release, 27/2/99).'

The FQC programme covers more than 80 fresh products sold by Carrefour, and more than 35,000 farmers and producers are partners in this programme. In the category of fresh produce, 50 per cent (or 24,000 tonnes) of all potatoes sold by Carrefour fall under the FQC. For carrots the figures are 90 per cent and 15,000 tonnes, for apples 30 per cent and 15,000

[1] For more information, see: www.farre.org.

tonnes and for red beet 80 per cent or 500 tonnes (Carrefour Press Release, 27/3/99). Carrefour does not use a special label to present its FQC programme, but advertises it as a token of its dedication to environmental protection.

*Bonduelle*

Bonduelle is a major French producer of preserved vegetables. On its web-site (www.bonduelle.fr) the company presents itself as a protector of the natural environment. As such it promotes cultivation methods that require minimum amounts of fertilisers and chemical plant protection. It encourages its suppliers to use methods of integrated crop management (which Bonduelle names agriculture contrôlée). Bonduelle exerts strict quality control over all parts of the cultivation practices used by its 5,000 supplying farmers. These farmers must contractually comply with the good agricultural practice system, including strict requirements for chemical plant protection. Bonduelle is involved in studies on integrated or controlled farming methods.

## 3.8 Concluding remarks

Major structural changes are taking place in the European agrifood sector. Processes of concentration and internationalisation have given food retailers substantial market power vis-à-vis their suppliers. This in turn has triggered a process of consolidation among food processors, wholesalers and even farmers. All firms participating in a production and distribution chain for agricultural and food products - farmers, processors, wholesalers and retailers - are increasingly working together to gain efficiencies in logistics and information exchange and to set up quality monitoring and control systems throughout the chain.

Consumers in Europe have become more concerned about the quality of food products, but also about the quality of production and processing methods applied on the farm and in the manufacturing plant. Such consumer concerns relate to food safety and quality, environmental sustainability and ethically appropriate methods of production. The use of plant protection products is a prominent issue among these concerns. As a result, farmers, food processors and retailers have initiated efforts to guarantee safe products produced in a sustainable way. The environmental issue has even become part of the competition strategy of farmers, food processors and retailers.

Food retailers have become particularly concerned about the quality of fresh produce because either they sell top quality products under private label or they advertise their company as being an environmentally conscious food supplier. Not only fresh produce like fruit and vegetables are increasingly sold under private label, also chilled foods, ready-to-eat meals, prepared vegetables and fruit salads are popular products within the own-brand strategy. For private label products, retailers take responsibility for quality, because it is their brand that is at risk if quality flaws appear.

These structural changes in food processing and food retailing lead to more elaborate quality control systems throughout the whole agrifood chain. Quality control at the point of purchase is no longer sufficient, as some quality characteristics cannot easily be measured and as the cultivation methods used on the farm have become part of the quality characteristics of the final product. Food processors and retailers set strict requirements for sustainable cultivation practices by their suppliers. Quality monitoring and control systems also give food processors and retailers more insight into the primary production parameters, and thus more options for (re) directing cultivation decisions. Once measurable sustainable agriculture indicators have been established, it becomes possible to select and reward suppliers on the basis of their score on these indicators.

Changes in market structure, in vertical alignment of production, distribution and sales, in food retailer strategies and in quality control of processes and products have implications for the use of plant protection products in cultivation and post-harvest activities. First, as private label products (fresh produce, chilled products, etc.) are strategically important for retailers, these companies will not only dictate quality requirements but also be actively involved in enhancing quality throughout the whole production and distribution chain. Retailers will encourage their suppliers to adopt sustainable production methods, including minimal use of plant protection products, and targeted use of a selected number of active ingredients.

Second, consumer demand for year-round availability of fresh produce on the one hand and concentration and internationalisation of retailers on the other hand lead to world wide sourcing of food products. As a result, farmers in many countries will apply the same cultivation guidelines (including restrictions on the use of plant protection products). The EUREP protocol for Good Agricultural Practice can be seen as a European harmonisation of private quality criteria for fresh produce (including criteria for use of plant protection products).

Third, ICM programmes are becoming increasingly important, all over Europe. Both growers and purchasers (food processors and food retailers) have set up ICM programmes. As the use of plant protection products is a major element in these programmes, they contribute to a more targeted use of plant protection products across the EU.

Fourth, as part of their differentiation strategy retailers and food processors are actively involved in product innovation. New products have to comply with the requirements on low (preferably lower) environmental impact. As the farming accounts for the largest share of the environmental impact of the whole food production and distribution chain, food processors and retailers will increasingly incorporate requirements for cultivation methods in their innovation goals. Thus, the development and introduction of new food products will lead to more constraints for on-farm use of plant protection products. In the vegetable industry, we will see retailers and processors contracting with seed producers to develop varieties with special characteristics, including enhanced disease and pest resistance.

The quality control mechanisms developed by food processors and food retailers are expected to become more widespread in Europe in the years to come, at least in part due to the concentration and internationalisation in the European agrifood sector. Current trends in The Netherlands, France and UK, promoting the adoption of ICM in agriculture, is expected to be-

come more widespread over Europe due to the acquisition of other retailers on the Iberian Peninsula and in Central Europe.

Retail strategies focusing on low prices, which currently prevail among retailers in Germany, may have a different impact on the use of plant protection products. These retailers do have marketing strategies that put emphasis on meeting environmental standards that are legally required, and they do not set up ICM schemes for suppliers. As margins of production for farmers supplying these retailers are small, they are pressed to economise on production costs. One element in these costs is the use of plant protection products. Producing against lowest cost possibly would suggest a rational use of plant protection products, in other words as limited as possible. However, it may also put pressure on farmers to use relatively old and cheaper products instead of new and possibly more expensive products with a better environmental performance. Moreover, as farmer knowledge is a major factor explaining the use of plant protection products, retailers competing on price do not support to generate and transfer improved knowledge on crop protection. Given these opposite influences, it remains difficult to argue which implications the price competition retail strategy has on the use of plant protection products.

# 4. The policy dimension of plant protection, agriculture and the food chain

## 4.1 Introduction

Human health and environmental requirements increasingly put conditions to farmers in Europe and elsewhere in the world, to provide healthy and safe food. Public concerns on the quality of food have led to the imposition of strict standards upon modern agricultural production systems. This chapter is mainly focussing on the policy dimension of such trends. The key objective of this chapter is to identify key trends in agricultural and environmental policy, which are foreseen for the next decade, and may affect the interaction between agriculture and plant protection to a large extent. Also, some key features of EU and national policies are presented to focus on the authorisation procedure and other measures to control usage of plant protection products.

Two policy items are of vital importance to European agriculture in their attempt to enhance the competitive position of agriculture on the world market, including:

- Accession of Central and Eastern European Countries, which may alter market conditions in the next 10 years to a large extent.
- Liberalisation of agricultural markets following multilateral agreements, mainly in the context of the World Trade Organisation (WTO).

Both factors are main driving forces to liberalising agricultural policy in the European Union (EU), reducing price and market support measures, including border measures and intervention prices.

This chapter examines the policy dimension of plant protection in the EU. Emphasis is given to the potential implications for the protection of crops following the changes in public policies, including various market regimes of the CAP, the move towards Integrated Rural Development in the context of the CAP, and national requirements in the context of environmental policy targets.

## 4.2 The changing role of the CAP in meeting societal demands

*The Common Agricultural Policy (CAP) in the EU*

Agricultural policy in the EU is a common policy, and the original objectives of the Common Agricultural Policy (CAP) are set out in the 1957 Treaty of Rome:

- to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimal utilisation of the factors of production, in particular labour;
- thus to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture;
- to stabilise markets;
- to ensure stability of supplies;
- to ensure that supplies reach consumers at reasonable prices.

The European Agricultural Guidance and Guarantee Fund (EAGGF) finance expenditures on the CAP. The CAP has a large share of the budget since the European Union has a major obligation to regulate agricultural markets through economic instruments, based on market unity, financial solidarity and Community preference (Lowe and Baldock, 2000). Market and price support measures are the key instruments applied under the CAP. Over time, they have provided incentives for a rise of production levels. The reform of the CAP in 1992 was a response to the discussions on agricultural trade during the Uruguay round of the General Agreement on Tariffs and Trade (GATT). By that time, measures were adopted in order to reduce surplus production, to improve the competitiveness of EU agriculture on the world market, to restore market balance and to stimulate less intensive production methods. Intervention prices were reduced for several commodities (cereals, oilseeds, protein crops, beef and lamb), and farmers were compensated through hectare premiums (arable sector) or headage payments (subject to a ceiling on stocking density).

*Pressures to reform agricultural policy in the EU*

The reform of the CAP, as concluded in 1999 and proposed in Agenda 2000, aims to anticipate the coming international trade round of the WTO on trade liberalisation. A programme of work for these upcoming negotiations is expected in the course of the year 2000. Agenda 2000 is the document in which the European Commission seeks to define the agricultural policy of the EU for the years to come and to mark the boundaries that are acceptable to the EU Member States prior to the start of this new trade round. Pressures to reform agricultural policy exist both for internal and external reasons, which are clarified in the following.

First, in the Uruguay Round Agriculture Agreement (URAA), which was signed in 1994, consensus was reached on increasing market access, reducing export support, as well as reducing trade-distortive domestic support. Programmes that restrict production, which form part of the 'blue box', have a temporary character and may be discontinued in 2003. The EU will probably have to transform this aid by a substantial amount from 2004. In addition, agreements were made in the GATT agreement on the 'green box', which comprises support measures that are not linked to production indicators (such as physical yield, cultivated area or numbers of animals). The 'green box' measures are supposed to have no or hardly any disruptive effect on trade, and expenditure on these measures does not have to be reduced.

Environmental payments must be part of a 'clearly defined governmental agri-environmental programme and be dependant on the fulfilment of specific conditions' (Paragraph 12 of Annex 2 of the URAA). The new trade round, which may start early 2001, is expected to lead to more detailed agreements on the reduction of support or on making the provision of support dependent on the fulfilment of additional conditions.

Second, the accession of Central and Eastern European Countries (CEECs). The further enlargement to the CEECs puts increasing pressures to reform agricultural policy. The accession of CEECs would have major budgetary consequences and the legitimacy for the provision of price support measures is discussed as well. Expenses of agricultural policy would increase sharply in case these countries would enter the Union with current systems of direct payments.

*The European model of agriculture*

European agriculture is characterised by a broad heterogeneity of production systems with wide-ranging geographical features. Intensive production systems tend to put pressure on the environment, whereas traditional farming practices may jointly provide agricultural commodities and environmental goods and services. The multi-functional nature of European agriculture and its role in conserving the countryside is vital to understanding agriculture's role in society, and its importance for the economy and the environment. This is also acknowledged with the reform of Europe's agricultural policy under Agenda 2000. This 'European model of agriculture' focuses on the key features for agricultural development in the near future. In this context, emphasis is placed upon establishing an economic sector that is versatile, sustainable, competitive and dispersed throughout Europe. It must be capable of maintaining the countryside, conserving nature and making a key contribution to the vitality of rural life.

*Integrated Rural Development as the second pillar of the CAP*

A 1997 report of a group of experts chaired by Alan Buckwell has examined the transition of the CAP towards the integration of environmental and rural development objectives. Three major arguments were presented to propose such an adjustment of the CAP:

- first, the changes regarding the societal demand of agriculture. In addition to requirements on the supply of food, society increasingly demands for the quality of food and the production methods applied;
- second, the changes, which take place on the contribution of the farming community in managing the rural countryside. The contribution of farmers in managing the countryside is increasingly acknowledged;
- third, the major role that European agriculture has on the world market. The EU has a share of 12 per cent of global trade in agricultural products (exclusive of intra-trade among Member States), which is slightly below that of the USA (a share of 15 per cent of global trade). It would be difficult to maintain such a dominant role of EU agriculture

on the world market while maintaining a local market with market prices that exceed world market prices together with a system of export restitution.

The report (European Economy, 1997) proposes to transform the CAP from market and price support measures into direct payments. Such a policy would consist of four elements:

- market stabilisation, with a gradual reduction of financial resources for market intervention;
- payments for targeted environmental conditions and management of cultural landscapes. The budgets for such payments would increase over time with the tightening of conditions put to farmers;
- payments for rural development measures, which are aimed to strengthen the agricultural functions in the rural countryside;
- transitional payments to assist the adjustments to an agricultural and rural policy for Europe, which would gradually be extended for rural development initiatives.

The model, which was offered by the Buckwell group involves the move away from the control of agricultural markets, and the adoption of compensatory measures, which are decoupled from production. They proposed the use of public resources for the management of the rural countryside and the socio-economic development of rural areas.

The Agenda 2000 reform in 1999 did formulate the elements to guide the transition from the CAP to Integrated Rural Development. The agreement made at the Summit with heads of state in March 1999 was significantly less ambitious than what was originally proposed by the Commission (Lowe and Brouwer, 2000). Current measures include a Rural Development Regulation (Regulation 1257/1999) which is aimed to:

- support a viable and sustainable agriculture and forestry sector as part of the rural economy;
- develop the territorial, economic and social conditions which are considered to be necessary for maintaining the rural population;
- maintain and improve the environment, the countryside and the natural heritage of rural areas.

This regulation has formulated several objectives of rural development policy, including the maintenance and promotion of low-input farming systems and the preservation and promotion of a high nature value and a sustainable agriculture respecting environmental requirements. It builds on the wide diversity of production systems, which currently exist in Europe and are vital to maintaining the multi-functional nature of agriculture. The reforms of agricultural policy during the 1990s allows the farming community to follow a divergent trend in the years to come, with part of the agricultural sector to continue intensification of production. Such farmers focus on the provision of food and will face a reduction of market support in the years to come. In addition, part of the farming community continues to deliver agricultural goods and provide services for which they are remunerated. This diversity of farming

systems is reflected by the three options to integrate environmental requirements in agriculture. They will be compared in the following section.

## 4.3 Three approaches to integrate environmental concerns into farming

Member States need to implement actions to ensure that farms receiving direct payments are meeting environmental protection requirements. According to Article 3 of Council Regulation (EC) 1259/1999 establishing common rules for direct support schemes under the common agricultural policy ' … Member States shall take the environmental measures they consider to be appropriate in view of the situation of the agricultural land use or the production concerned and which reflect the potential environmental effects'. Considerable latitude remains with Member States in deciding what is appropriate. As such, three approaches are currently available to internalise external effects of plant protection products into farming practices:

- First, general mandatory environmental requirements in meeting the legal constraints, and the application of minimum environmental conditions in agriculture that all farmers need to comply with. It may include measures to control the use of plant protection products. A summary of measures to control the use of plant protection products is presented in figure 4.1. Part of them relates to the implementation of Directive 91/414, which provides a legislative framework on the authorisation of such products. In addition, several rules mainly derive from national measures and may therefore be largely variable across Member States. Measures to control the use and drift of plant protection products are of major concern and have a high priority in policy in the EU. Similarly, it also is a major issue with high priority in the USA and Canada (Brouwer et al., 2000). The wide range of restrictions that applies to agriculture in the Member States has contributed to the declining trend in use of plant protection products. Farmers have been searching for new means to meet the targets in public policy. New active ingredients have been put on the market. Chemical industry supplied new products, which allow for more targeted use and lower dosages.
- Second, support for agri-environmental schemes and the provision of environmental conditions to agricultural support measures for farmers, delivering environmental 'services' on a voluntary basis. An additional payment can be provided if an extra effort is made, which must go beyond the requirements (applicable to cross-compliance) and laid down in a Code of Good Agricultural Practice. Farmers are eligible for compensatory payments on a voluntary and contractual basis for the provision of environmental services that are defined in the programme. About 17 per cent of the agricultural land in the EU are subject to management agreements under Regulation 2078/92, covering some 22 million hectare (table 4.1).
- Third, attach specific environmental requirements that put a condition for direct payments under the CAP. This is commonly called cross-compliance. A few member states have put environmental conditions to support payments. Environmental conditions have

been introduced in the Netherlands to the production of maize and starch potatoes. Chemical weed control is not permitted in maize production between April 1 and July 15, unless between sowing and July 15 at least once mechanical control is applied. In such case, the amount applied should not exceed 1 kg per hectare. Haulm killing is not permitted in the production of starch potatoes. In the event of cross-compliance, the amount of income support is not reduced if a farmer meets the relevant environmental and conservation conditions. The penalty is a reduction or possibly even the withdrawal of income support. Denmark did put environmental conditions on fertilisation and the livestock sector (Christensen and Rygnestad, 2000), which however reinforce current legislation. In France, the abstraction of water by agriculture for irrigation purposes is under cross-compliance conditions.

The existing experience in applying cross compliance measures indicate the possible implications of putting environmental conditions to the provision of support payments in some countries. However, it is still too early to judge the effects of such measures for use of plant protection products in the European Union. Some Member States may also decide that current legislation would suffice to meet the requirements of Article 3 from Regulation 1259/1999 (Dwyer et al., 2000).

*A proper definition of the term Good Agricultural Practice is essential*

A Code of Good Agricultural Practice (GAP) can be used as a benchmark for the conditions a farmer needs to comply in order to be qualified for compensatory payment. A proper definition of GAP is essential to allow distinguishing between the three strategies defined above, and identify the conditions that a farmer be qualified for compensatory payments. It includes the requirements that reflect farm management practice, which ties in with the existing legal framework, and which a farmer needs to meet on his own costs. A penalty would be imposed under cross-compliance on part of the direct payments to farmers who do not meet the specific environmental requirements that are conditional for direct payment.

A Code of Good Agricultural Practice might build along the principles of ICM/IPM. They require techniques and methods applied in farming to maintain pest populations below those causing economically unacceptable damage or loss. Regional measures exist in Spain to provide support for participants into IPM in selected environmentally sensitive areas, covering almost 15,000 ha with an average payment of 230 ECU per ha.

| | |
|---|---|
| What products can you buy and are available for use? | In total 808 active substances (organic and inorganic) were authorised in EU countries by mid 1993. By the time of writing the first stage of the review procedure is not completed yet. The second stage of the review programme is under preparation. There is a downward trend on the available products. The limited number of active ingredients is a critical factor of plant protection in some countries (e.g. Germany), especially for growing crops that are limited. |
| Do phase-out actions exist? | Authorisation of plant protection products shall not be granted in the context of Directive 91/414 in the following case. First, if the concentration in groundwater is expected to exceed the drinking water limit, formulated in Directive 80/778/EEC. Second, if the limits of Directive 75/440/EEC would be exceeded in surface water, intended for the abstraction of drinking water. Approval of products is normally granted for a period of up to 10 years, and subject for renewal. |
| What constraints apply to permissible use of plant protection products? | Member States must prescribe that plant protection products be used in accordance with the principles of good plant protection practice, in accordance with the conditions of the authorisation and specified on the label, and whenever possible, in accordance with the principles of integrated pest control. Several Member States require plant protection products to be used in accordance with good agricultural practice. Their use is not permitted if the user must expect harmful effects on human and animal health or on groundwater. |
| What controls apply over use of plant protection products | ? Several countries have requirements for training and certification for professional sprayers of plant protection products. In Italy, for example, users must hold a license in order to buy certain toxic products. Among other Member States, In Denmark, mandatory training is required, as well as a certification, that is required for professional sprayers.<br>? Control over aerial spraying of plant protection products and period inspection of equipment.<br>? The use of soil disinfectants is strictly controlled in the Netherlands. |
| What advisory bodies strengthen regulatory action? | Ministries of the Environment normally are the primary authority establishing and administering rules concerning marketing and use of plant protection products, including registration. National Ministries normally are also involved in occupational health aspects, whereas Ministries of Agriculture may be responsible for monitoring and evaluation health effects from residues on food. |
| What constraints apply when shifting to IPM? | Compared to conventional pest control, the principles of Integrated Pest Management are insufficiently known by farmers, where high requirements by consumers on product quality and zero-tolerance limit a wide scale application of IPM. Labour input normally is higher because of mechanical weed control. Periodic inspection of the field would be essential to identify any pests in an early stage. Also, decision tools are vital to identify when and what actions need to be taken. |
| What taxes apply to the use of plant protection products? | Some countries have taxes (Finland, Sweden, Denmark, Belgium and the UK), ranging from a few per cent up to a third on retail price in Denmark. Where existing, the instrument is primarily introduced to reduce use of plant protection products or to support input reduction programmes. They are used in part to finance national policy measures. |
| Constraints for storage and disposal of plant protection products | Measures are taken by several Member States to control the labelling and packaging of hazardous substances (including plant protection products), including regulations for disposal and rinsing of packaging. Several industrial efforts are taken to take-back and dispose of active ingredients, which are expired, and not authorised for use. |

*Figure 4.1 Measures to control the use of plant protection products in the EU*
Sources: Oppenheimer Wolff & Donnelly (1996); Rayment et al. (1998).

*Table 4.1 Take-up of aid schemes under Regulation 2078/92 at mid-1997 (1996 for Italy)*

| Country | Total number of 2.078 contracts | No. of contracts as % of total farms (%) | No. of contracts as % of all (%) | Total area under contract (ha) | Proportion of total UAA under contract (%) |
|---|---|---|---|---|---|
| Austria | 168,804 | 75.9 | 12.5 | 2,500,000 | 72.9 |
| Belgium | 1,242 | 1.7 | 0.09 | 17,000 | 1.2 |
| Denmark | 8,193 | 11.8 | 0.6 | 94,000 | 3.4 |
| Finland | 91,509 | a) | 6.8 | 2,000,000 | 91.2 |
| France | 177,695 | 24.1 | 13.2 | 5,725,000 | 20.2 |
| Germany | 554,836 | a) | 41.2 | 6,353,000 | 37.0 |
| Greece | 1,839 | 0.2 | 0.1 | 12,000 | 0.3 |
| Italy | 63,841 | 2.5 | 4.7 | 977,000 | 6.6 |
| Ireland | 23,855 | 15.5 | 1.7 | 801,000 | 18.5 |
| Luxembourg | 1,922 | 60.0 | 0.1 | 97,000 | 76.9 |
| Netherlands | 5,854 | 5.1 | 0.4 | 31,000 | 1.5 |
| Portugal | 125,479 | 27.8 | 9.3 | 606,000 | 15.4 |
| Spain | 29,599 | 2.3 | 2.1 | 532,000 | 2.1 |
| Sweden | 68,969 | 77.6 | 5.1 | 1,561,000 | 51.0 |
| United Kingdom | 21,482 | 9.16 | 1.6 | 1,322,000 | 8.1 |
| TOTAL | 1,345,119 | 18.3 | 100 | 22,628,000 | 16.5 |

a) Impossible to determine with any accuracy as many farms hold multiple contracts
Source: Buller (2000).

## 4.4 Concluding remarks

We may draw some concluding remarks on the policy dimension of plant protection in the EU.

- First, a GAP is increasingly needed to formulate the conditions that a farmer needs to meet on his own costs. Farmers who meet conditions that go beyond such GAP would be eligible for compensation of the costs involved of doing so. ICM and IPM might help limiting the number of Codes for the control of plant protection products. The adoption of ICM and IPM would also harmonise the requirements for GAP. In the USA, for example, the promotion of IPM is one of the goals in the food safety rules, and about 75 per cent of the crop land should be under IPM by the year 2000. It includes the period inspection on a field for pests and such pest scouting is considered to be necessary to determine whether actions need to be taken. Measures to be taken might be based on physical control as well as biological and chemical control.
- Second, GAP is needed in cultivation and post-harvest activities. Codes of Good Agricultural Practices - as developed by the EUREP - are important to harmonise product quality for fresh produce. Such private market initiatives would also be relevant from a

public policy point of view. The European Commission might link the certificates for Good Agricultural Practice, developed by the EUREP, for the provision of compensatory payments. Such efforts might improve the implementation and enforcement of legislation, harmonise rules applied to farming in the EU and subsequently also reduce the administration costs of running public policies. This process may extend in the years to come, if food retailers and food processors from the north-western part of Europe (e.g. the UK and the Netherlands) increase their efforts to establish their markets in southern Europe and merge with food companies in countries like Spain and Portugal.

- Third, the European model of agriculture aims to maintain the viability of both producers of food and of rural amenities. Intensive production systems could maintain the diversity of production systems in Europe, because of the available land resource to allow for more extensive production systems. Both systems are aimed to provide safe and healthy food that meets public demands. This process is to be guided by the provision and use of plant protection products, which meet these requirements.
- Finally, environmental policy on plant protection products tends to increase on integrated production methods and several transitions are currently taking place. First, a transition from the control on use towards the adoption of farm management aspects. Second, a transition from general measures that apply to all farmers to measures which specifically address certain production methods and agricultural holdings. Finally, linkages are established between environmental quality with food safety.

# 5. Outlook

Some concluding remarks are drawn from this study examining the dynamics in crop protection, agriculture and the food chain in Europe.

Agricultural production in the European Union has increased largely during the past decades. European agriculture has transformed since the 1950s, when food demand was met at least in part by the import from foreign countries. Since then, supply even exceeded demand for some commodities and surpluses have been observed (e.g. cereals, sugar and wine). Incentives to increase production have been given through market support measures. The availability of plant protection products guided this transition phase of European agriculture, which lasted until the mid-1980s.

Societal debate that started in the late 1980s has given incentives to better control the environmental effects of farming practices. Policy also aimed to reduce surplus production of food. Since then, the interest moved towards a more targeted and rationalised use of plant protection products. The use of plant protection products tends to decrease. Mandatory requirements on the use of plant protection products increasingly tends to include farm management aspects (rather than measures to reduce total use), focus on specific measures (rather than general measures that apply to the whole agricultural sector) and to link environmental quality with food safety aspects. Plant protection products therefore need to be more targeted and requiring lower dosages.

The farming community increasingly responds to the societal demands regarding production methods applied in European agriculture. Such societal demands might be reflected by rules on the use of plant protection products, put either by food processors and food retailers, or by public policies. In some Member States in northern Europe, farmers currently respond to the rules put by retailers, including conditions that are in place regarding the use of plant protection products. Codes of Good Agricultural Practice are important in the attempt to clarify the responsibilities in managing environmental resources by farmers. Under Agenda 2000, the adoption of GAP is linked to direct support payments. Current experience on the adoption of cross compliance measures in EU Member States within the framework of Article 3 of Regulation 1259/1999. The current measures have limited implications for the use of plant protection products in the EU.

European agriculture is an important producer of food in the world. A substantial share of the export of cereals and cereal preparations, as well as sugar and sugar preparations is to non-EU countries. The level of price support is gradually diminishing. Liberalisation means that agriculture in the EU must increase its competitiveness. The EU would have to bring down its trade barriers. The increasing competition of agricultural production may increase in-

tensification of agricultural production in regions with comparative advantages, and plant protection products would be necessary to enhance such trend.

The ambition of European agricultural policy, as expressed with the reform of Agenda 2000, is to enhance the sustainable and viable nature of the agricultural sector. This is supported by policies, which acknowledge the wide diversity of farming systems. In addition, the public increasingly demands healthy and safe food. The plant protection industry will play a vital role in the supply of new products, which allow for a more targeted use, meet environmental requirements and are safe for human and animal health.

Retailers and food processors are demanding better and audited farming systems in response to changed consumer demands. Therefore, agriculture must respond to and work with others in the agrifood chain. The adoption of ICM and IPM would qualify for the formulation of GAP.

Pressure from the agrifood chain and consumer demands imply that the crop protection industry must provide safer, environmentally-friendly plant protection products which are more targeted and requiring lower dosages.

Public-private partnerships may be the way forward for meeting societal demands to the agricultural sector. The incorporation of environmental concerns in marketing strategies from retailers could change farming practices and also contribute to reduce efforts needed for meeting public policy objectives.

The plant protection industry normally takes a long-term perspective to respond to changes in societal demands. This time horizon may extend the period of agricultural policy reform. Plant protection industry therefore has to adopt future reforms into their current strategies and consider liberalisation of agricultural markets in the EU, decoupling compensatory payments from production and increasing the support for the environmental management functions of agriculture and the socio-economic development of rural areas.

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# Appendix 1 Classification of agricultural holdings

Agricultural holdings are classified according the Standard Gross Margin (SGM). It is the Community typology for agricultural holdings to arrange that homogeneous groups of holdings can be assembled in a greater or lesser degree of aggregation. Farms essentially are grouped according to the economic size and type of farming. The SGM is a regional coefficient expressed in terms of ECU, per hectare or per animal. Such coefficients are identified for each type of crop and for each type of livestock.

The classification of farm type at the level of individual holdings includes the following steps:

- the different enterprises (units of crop and livestock characteristics) are valued (multiplied) by economic parameters called Standard Gross Margins (SGM) coefficients in ECU;
- the results of these valuations are summed up; this sum (total SGM of the holding) is converted into European Size Units (1 ESU = 1,200 ECU) and used as a measure of the economic size of the holding;
- the relative contribution (in per cent) of the different enterprises to the total SGM of the holding is calculated;
- on the basis of its total SGM and the relative contribution of its different enterprises, the holding is classified according to its type of farming.

The calculation of the economic size of an agricultural holding in ESU (European Size Unit) includes several steps:

- the different enterprises (types of crops and types of animal categories) belonging to the holding are identified;
- the area of each crop (in ha) and the number of heads per category of animal are determined;
- the individual SGM value of each enterprise is obtained by multiplying the area or the number of heads by their corresponding SGM coefficients;
- the total SGM of the holding is the sum of the individual SGM values taking into account the fodder equilibrium;
- the economic size of the holding is expressed in ESU (European Size Unit).