LMC INTERNATIONAL

EVALUATION OF MEASURES APPLIED UNDER THE COMMON AGRICULTURAL POLICY TO THE PROTEIN CROP SECTOR

Main Report

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Glossary

This Glossary introduces a number of technical concepts, which relate to the Common Agricultural Policy (CAP) or the methods of analysis that are employed in this report.

Arable Aids, Area Payments or Direct Payments: These are payments made to producers of cereal, oilseed or protein crops on a per hectare basis under Regionalisation Plans (see below).

Coefficient of variation: This is the ratio of the standard error of a variable to its mean value. In this evaluation, it is used to judge the volatility of variables such as yields over a period.

CNDP: Complementary National Direct Payment

Direct costs of production: These are specific costs, using the definition employed by FADN, and combine the costs of seeds, fertilisers and chemicals per hectare. These costs are nominal.

Full gross margin per hectare = (Gross margin at market prices + Coupled aids) per hectare.

Full income per hectare = Income per hectare + decoupled aids.

Gross margin per hectare at market prices = Revenues from sales at market prices – direct costs of production, all expressed per hectare.

Income per hectare = Full gross margin per hectare + rotational benefits.

MGA: Maximum guaranteed area. In the case of protein crops, this is the area which receives the maximum amount of coupled payment per hectare. If the maximum guaranteed area is exceeded, the area payment per hectare is reduced *pro rata*.

Mixed Crops-Livestock: This is one of the standard types of farming established by FADN in its sampling approach. A farm enterprise is in this category if more than two-thirds of the farm's standard gross margin are obtained from mixed crops-livestock farming. This category includes livestock farms that grow cereals for use as on-farm feed for their animals.

Regionalisation Plan: When direct payments were introduced, Member States had discretion as to how they determined them, in terms of the number of sub-regions and the number of crops for which separate reference yields were calculated. The formulae for the computation of the reference yields for individual crops were laid down by the Council, but Member States could determine regionalisation plans that allocated different reference yields to different classes of cereals. The main distinctions in reference yields in some national regionalisation plans were made between maize and other minor cereals, on one hand, and the remaining cereals, on the other; and between irrigated and rain-fed cereals. Member States also had the option of determining different reference yields for set-aside land.

Revenues from sales = The producer price per tonne x yield per hectare. All the revenue estimates used in the report are prepared in terms of nominal values.

Rotational benefits. These quantify the monetary benefits resulting from the higher yields for the following cereal crop and the reduced nitrogen requirements in the following crop.

SAPS: Single area payment scheme

Specialist Cereals, Oilseed and Protein Crops (Specialist COP Crops): This is another standard category of farming established by FADN in its sampling. A farm enterprise is allocated to this category if more than two-thirds of the farm's standard gross margin are obtained from cereals, oilseed and protein crops farming.

SPS: Single payment scheme

UAA: Utilisable agricultural area

Calendar and marketing years

Throughout the report, we refer simply to calendar year numbers (e.g., 2000, 2001, etc). In most cases, these refer to the marketing years beginning in July, where, for example 2000 is understood to be 2000/01. For the data relating to trade, consumption and feed ingredients, the data are expressed on a calendar year basis.

The classification of protein crops

There are different types and qualities of the three protein crops, field peas, field beans and sweet lupins. These distinctions typically relate to different end-uses.

Field pea varieties differ by colour (e.g., yellow, white and green) or by physical property (e.g., marrowfat peas for food uses). Field peas for food uses have higher quality specifications than those used in feed, but they also are specified in terms of particular colours and varieties, unlike those destined for feed. The different varieties and qualities of field peas command different prices. The only widely quoted regular weekly prices in the EU market relate to the main end-use, feed. These peas are typically referred to as "feed peas", to distinguish them from premium-priced qualities, which are used mainly in food uses and in special feed markets, such as pet food. The latter as a group are commonly known as "food peas", even if used in pet food. In the text, the terminology "feed peas" will be used to refer to field peas destined for the bulk feed market, where the discussion refers specifically to the products used in this particular end-use.

Field beans also have both feed and food uses. As with field peas, the contractual specifications for the products in food uses are more stringent. The field beans destined for feed uses are typically referred to as "feed beans", while those destined for food uses are commonly known as "fava" or "faba beans".

Sweet lupins cover a number of varieties, differing by colour, but virtually all are destined for the bulk feed market, and food uses are no more than a niche using, it is estimated, barely 1,000 tonnes per annum in the entire Community.

List of acronyms

COPA–COGECA: Committee of Professional Agricultural Organisations and General Confederation of Agricultural Cooperatives, Brussels, Belgium

FEFAC: European Feed Manufacturers' Federation, Brussels, Belgium

INRA: Institut National de la Recherche Agronomique, France

MARM: Ministerio de Medio Ambiente y Medio Rural y Marino, Spain

PROLEA: Plateforme de Communication de la Filière des Huiles et Protéines Végétales Françaises, France

UNIP: European Union Nationale Interprofessionnelle des Plantes Riches en Protéines, France

Chapter 1: Background to the Evaluation and Methodology

1. Evaluation scope and objectives

This report presents an evaluation of the impacts of CAP measures applied in the protein crop sector. It forms part of a series of evaluations of CAP measures concerning sectors that are subject to past or present direct support. The focus of this evaluation report is the impact on the protein crop sector in the EU-27 of the measures introduced in Council Regulation 1782/2003. The measures that have special relevance to the protein crop sector in that reform are the following instruments:

- Partial integration of the previous aid for protein crop production into the Single Payment Scheme (decoupled aid as established by this regulation);
- Special aid for protein crops (coupled aid detailed in Arts. 76-78 of the same regulation);
- Single Area Payment Scheme (Arts 143(a)–143(c) of this regulation) which was implemented in all but two new Member States.[1]

In order to capture the effects of the policy changes introduced in 2003, the report takes into account the measures applied previously under Art. 4(3) of Council Regulation 1251/99, fixing basic amounts paid per tonne of protein crops and other arable crops. While the evaluation examines the impact of CAP measures applied in the protein crop sector since the 2003 reform, data are analysed from 2000 to assess the impacts of the new measures and instruments introduced after 2003.

The evaluation examines the effectiveness, efficiency and relevance of the protein crop measures in achieving their objectives and their coherence with the reformed CAP after 2003. The deadweight and the possible unintended side-effects of the measures are also assessed; as well as effects with regard to environmental benefits, crop rotations and organic farming.

The second part of this chapter summarises the methodology applied in this evaluation, the evaluation tools that have been used and their limitations, as well as the information sources used in the analysis.

2. Data and methodology

2.1. Data used

The methodology behind this evaluation relies on six main sources of data:

- The FADN database
- International, national and regional data bases
- Questionnaires (submitted to producers and feed compounders)
- Interviews with associations and public and private institutions in the sector
- Six case studies undertaken in France, Germany, Hungary, Poland, Spain and the UK that form an important part of this report. The results of the case studies are presented in the form of monographs.
- A case study of the Canadian protein crop sector (the largest exporter of such crops).

[1] The analysis of the impacts of the Single Area Payment Scheme (SAPS) considers the complementary national direct payments (CNDPs) if they are applied to the protein crop sector by new MS. Malta and Slovenia were the only new MS to adopt the SPS since the beginning; Hungary will do so from 1 January 2010.

Analysis of the FADN farm accounting database provides only indirect insights into the economics of protein crop production, since these crops account for only a small share of the total areas of producers of the crops. However, the data allow comparisons to be made of the gross margins of producers on similar sizes of holdings and similar specialisations for different proportions of their areas under protein crops to determine whether there is a relationship between the dependence upon protein crop production and the gross margins of producers.

International, national and regional databases, from public sources and academic and private sector institutions, are particularly valuable, since they provide time series of gross margin calculations for protein crops and alternative COP crops (i.e., the main cereal and oilseed crops), as well as estimates of the benefit of protein crops within alternative crop rotations.

The use of questionnaires provides insights into the responses of producers and processors to policy changes and to other factors influencing their behaviour[2].

Interviews with associations are used to provide background data and an understanding of trends within the protein crop sector.

The Canadian case study provides valuable comparative data for analysis.

Official data from Eurostat on the areas and production of individual protein crops in some MS differ from data from national sources for these crops. This is true, for example, in Germany, Malta, Poland and the UK in some years. For the 2008/09 marketing year, initial estimates prepared by Prolea and COPA-COGECA formed the basis for the area and output statistics.

Regional data series on protein crops from Eurostat are often incomplete; the latest regional data for the UK are for 2004. Therefore, we have relied upon national and regional databases to derive consistent time series for the analysis undertaken in the individual MS that are the subject of case studies.

Other sources, notably FAO, are used for some analysis in this report, for example, of the pattern of end-use demand. However, FAO data are not very current in some respects. In addition, there are, for individual MS, often important inconsistencies between the FAO data and that from other sources, such as MS government agencies.

2.2. Data limitations

Since we have had to make a synthesis of data from different sources, to ensure the accuracy of the resulting statistics, we compared them with the results of an analysis of budgetary data on expenditures on protein crops by MS, which are verified at a national level. It was very reassuring to find that our total protein crop area estimates for the EU-15 MS were within 0.5% of the combined areas implied by the budgetary expenditures since the 2003 reform.

Since the data used to analyse gross margins are drawn from a variety of different sources, with a differing geographical coverage, there are some limitations in the conclusions drawn from such analyses. Because of the variety of data sources, their definitions of direct costs, revenues and gross margins are not the same in every region analysed in this report; therefore, the raw data have been adapted to ensure that the same definitions of direct costs and revenues are applied in each case study. However, the coverage of important forms of revenue (such as coupled payments, derived from the regional data provided by the FADN database) may differ in its geographical scope from the gross margin data, which is often for regions that form only part of the larger area grouped together within one FADN region.

[2] For example, the impact of disease on crop yields for producers of protein crops or the greater availability of protein feed ingredients for feed compounders as by-products of biofuel processing.

The FADN database itself suffered from limitations from the perspective of this report. Data are only available until 2006, and for new MS are available only since accession. Furthermore, as just mentioned, the regions into which FADN national data are divided are often larger than the regions selected as case studies within MS. Where this occurs, it has been assumed that the relevant information (e.g., regarding coupled and decoupled payments per hectare) for the broader FADN region is also applicable to the smaller region selected for analysis.

Since the FADN database was the source of data on coupled and decoupled payments per hectare of protein crops and other COP crops, for consistency, it was assumed that these payments in 2007 were made at the same rate as in 2006. This was believed to be a reasonable assumption because the full adoption of the SPS had occurred by 2006 in all EU-15 MS.

A further practical difficulty regarding the use of FADN data was created by the structure of protein crop production. These crops typically occupy only a small percentage of the total area of the farm on which they are grown. Since FADN data are collected by holding, it is not possible to draw conclusions about costs and, hence gross margins, for protein crops alone on these holdings.

Also, because protein crops are only grown on a minority of holdings, many categories of producers, distinguished by specialisation or size of holding, are represented by very few producers in the FADN sample. Where fewer than 15 holdings are covered by a particular category of protein crop producers, the need to preserve the confidentiality of individual returns has meant that results are not included in the analysis presented in this report.

We mentioned earlier the difficulties encountered with some FAO end-use data which have not been updated since 2004. For more recent years, we have assumed that internal demand for protein crops for human or pet food (e.g., as fava beans or as yellow peas) and for processing into foodstuffs, such as canned mushy peas or for bakery ingredients, were stable, while the demand for use in animal feed compounding was treated as a residual, which fluctuated with changes in protein crop supplies to the internal market.

Trade data from COMEXT were a source of some concern. Intra-EU trade in individual protein crops often did not balance between exporting and importing countries, creating errors in the derived consumption estimates by MS. In addition, analysis of foreign trade in sweet lupins led us to conclude that the correct category was product code 12092950, which is stated to be lupin seed for sowing.

Comprehensive price series are not widely available for protein crops. This is the result of several factors; for sweet lupins, a major cause is the high proportion of production used for on-farm feed, and thus not passing through markets; thus price data are typically available for only a few weeks in a year. For field beans, the concentration of marketing activity in the weeks or months after the harvest is the cause, and it results in a lack of reported price data outside that period. For field peas, there are two main sources of regular price data: Dutch data for supplies in Rotterdam and French data, which are available in producing regions, as well as in major feed using areas and at export ports.

A final limitation that is to be noted in the data used in this report relates to the treatment of the externalities, in the form of nitrogen fixation and increases in yields in the following cereal crop after the incorporation of protein crops into a crop rotation system. There are many scientific papers published on this subject, and there is a modest degree of difference of opinion about the magnitude of these benefits.

2.3. Regression analysis

Econometrics is employed as a quantitative tool to analyse the substitutability of protein crops for other vegetable protein sources. Regressions of protein crop prices as a linear function of feed cereal and soybean meal prices are used to analyse processors' and livestock producers' statements that protein crops are valued as a simple weighted average of the prices of the main carbohydrate feeds and the main source of vegetable protein.

Econometric analysis is also employed to assess whether a relationship can be found between changes in the areas planted to protein crops and the impact of the 2003 reform on coupled payments, and also to investigate the determinants of the price differentials between protein crops in human and pet food uses vis-à-vis bulk feed compounding.

2.4. Analysis of production costs, gross margins and producer responses

Any model to assess the impact of coupled and decoupled aid on the protein crop sector must be flexible enough to determine the effects of policy on different classes of producers, i.e., producers in different regions or employing different types of rotation.

We analyse production costs, incomes and gross margins derived from national and regional sources and estimate supply elasticities between the alternative COP crops, in a simplified form, in terms of observed changes in the relative shares of protein crop areas vis-à-vis changes in the relative gross margins of alternative crops. These very simple forms of supply elasticity are compared with producers' answers to questionnaires distributed in the six Member States selected for the case studies.

Using national and regional data from the case study MS, production costs, incomes and gross margins per hectare are estimated for two sets of crops: protein crops and alternative COP crops in the same geographical areas. In addition, for protein crop producers, margins are estimated taking account of the externalities from protein crop farming within crop rotations.

Simulations are developed for different regions and MS and for different protein crops.

Gross margins are quantified principally per hectare. That is the form in which most national and regional data are expressed, and in which the majority of producers assess the profitability of their farming activities, according to their responses to questionnaires.

The importance of other influences on planting decisions is also considered, taking account of answers provided during case study interviews, for example, about the volatilities of incomes and output, which are assessed from comparisons of coefficients of variation of the variables.

Another important aspect of the analysis of gross margins is the timing of the operations associated with protein crop production within the calendar year. Information from the questionnaires and interviews with producer associations is used to appreciate the constraints that exist upon producers' abilities to undertake the full range of operations needed for protein crop production alongside the production of other crops.

The benefits to the cereal crop that follows immediately after protein crops in a rotation are analysed in two different ways. One approach contrasts two popular six year rotations, one consisting of oilseeds in rotation with common wheat, and the other with protein crops alternated with oilseeds as the break crop in a wheat-based rotation. The second approach quantifies the revenue benefits averaged across other COP crops (i.e., all COP crops apart from protein crops) that are derived from nitrogen fixation and from higher yields in the common wheat crop that follows immediately after protein crops.

2.5. Calculation of supply elasticities

Producers' reactions are typically determined by the price that they receive for their production, the profitability of production and their ability to switch between crops. Comparing profitability in one year with changes in crop areas in following years provides a basis for estimating supply elasticities, and hence for analysing the impact of changes in policy, such as the counterfactual case, in which coupled aid is abolished.

This approach indicates how farmers responded to the reform introduced after 2003 and how they would be likely to respond to further change. Calculations of gross margins over time (taking account of rotations) quantify the way in which changes in the measures affecting protein crops and alternative COP crops have fed through to farm incomes. Time series data on changes in relative gross margins vs. changes in relative areas under alternative COP crops the following crop year (applying an adaptive model) yield a simple supply elasticity, defined as the % change in the protein crop share of the total COP area divided by the % change in relative gross margins for protein crops and other COP crops the previous year.

The questionnaires provide an alternative source of data about changes in gross margins, yields and production technology. Specific questions about the likely reactions to changes in coupled aids proved valuable in estimating the supply response to such changes, via a series of qualitative "pseudo-elasticities" estimated separately for each of the six MS.

2.6. Farmer questionnaires

Fieldwork in the six case study MS included interviews with farmers' associations, as well as interviews and questionnaires for a sample of 119 individual producers, (Poland 10, UK 13, France 18, Spain 25, Germany 26 and Hungary 27). These covered farmers' cropping decisions, crop rotations and how these have changed over time; their responses to changes in policy; production and cost data, including the externalities received in rotations.

2.7. Feed compounder questionnaires

Interviews were undertaken with processors' associations and with a sample of individual processors, of whom, 28 completed questionnaires. Several of these processors were active in a number of MS. These centred on the importance of the availability of domestic supplies of protein crops, the suitability of the qualities that are available, and the competition from other protein feeds, in particular competition from by-products of the biofuel sector, such as rapeseed meal and distillers' dried grains (DDG).

2.8. Choice of case study regions

Field work was conducted in France, Germany, Hungary, Poland, Spain and the UK. These are the four largest producers in the EU-15 and two largest in the EU-12. They provide a valuable cross-section of different conditions in the protein crop sector, including specialisation in different protein crops, on-farm use vs. commercial sales, feed vs. food end-uses, and internal market sales vs. export sales.

In these countries, interviews for farmers and processors were held in the following regions:

- France: Haute Normandie (a major production region for protein crops), Centre (with sizeable production and processing) and Bretagne (a big feed compounding region).
- Germany: Niedersachsen, where there is a significant local end-use of protein feeds, as well as local protein crop cultivation, including a significant organic segment.
- Hungary: A national focus was applied, as protein crop farming is widely dispersed.

- Poland: Mazowieckie and Warminsko-mazurskie are the regions selected, as major areas of end-use demand (much of which is used in on-farm feed in the country)

- Spain: Castilla-La Mancha and Castilla y León are the regions that were selected, as a significant area of the production and local consumption of the protein crops.

- UK: East Anglia was the region chosen for field research, both because it is the main area of production of field peas and beans, and because the majority of the field beans produced in the area are destined for export to third countries for food uses.

2.9. Limitations of the methodologies

The main econometric tool employed in the analysis is linear regression models. These are applied across regions or MS on a cross-sectional basis. The results of these cross-sectional analyses prove to lack statistical significance.

It is important, when interpreting the results of analyses comparing outcomes across different MS or different regions, to note that the models applied are simple models with a single independent variable. In each case all other factors that affect the geographical distribution of protein crop areas are assumed to have remained unchanged (the *ceteris paribus* assumption), which is a strong assumption in the light of major changes in world market prices for COP crops after the 2003 reform

Time series linear regression models that are applied to the analysis of protein crop prices in two different MS have greater statistical significance.

Simulations are frequently employed in the report, for example, to compare incomes per hectare (including rotational benefits) from protein crops and other COP crops with changes in planted areas, and to analyse the impact of changes in the geographical distribution of protein crop production upon yields and output in the EU. The former relies upon the estimates of rotational benefits and of direct costs and revenues, which are affected by the limitations mentioned earlier, that are associated with the data that are used.

Chapter 2: Theoretical Analysis of the Protein Crop Sector

1. The CAP measures applied to protein crops

This chapter provides an inventory of CAP measures applied to protein crops, and presents a logical diagram to illustrate the logic of official intervention in the sector.

1.1. The development of measures in the protein crop sector prior to 2003

The reforms that occurred in the measures in the protein crop sector during the review period (2003/04-2007/08) can best be understood in the context of the wider reforms in the CAP that began in earnest in the Agenda 2000 reform[3], away from price supports towards enhanced competitiveness and market orientation, alongside support for rural incomes and the promotion of rural development and environmental objectives[4].

It is valuable to describe the history of CAP measures in the sector. The first measures specifically targeted towards protein crop production in 1978 were introduced through Council Regulation (EEC) No. 1119/78. The protein crop sector was not protected from competition from imports by border measures. Import tariffs were minimal, and therefore intervention stock purchases, which were an instrument supporting prices in many sectors, were not a realistic option for protein crops. Instead, price support was provided by means of deficiency payments, designed to stabilise producer prices, while ensuring that supplies reached consumers at reasonable prices. At first, the measures were applied solely to feed uses of protein crops, but in 1982, the scope of the measures was extended to include the same crops sold for food uses

The MacSharry reform of 1992[5] brought measures in the protein crop sector closer to those applied to cereals. In the cereals sector, regional reference yields were established and a basic amount (in ECU per tonne) was determined which, when multiplied by the local reference yields for a particular cereal crop, established area payments that were paid at exactly the same rate per hectare to all producers of the same cereal crop within the same region. For cereals, the introduction of these area payments was associated with a cut in the intervention price. At the same time, supply control measures were introduced via compulsory set-side, limiting the areas planted to cereal, oilseed and protein (COP) crops. Environmental standards were introduced as a pre-condition for set-aside payments[6].

For protein crops, too, area payments were introduced from 1993. A basic amount of 65 ECU was applied per tonne from 1993/94 and reference yields were set in each region at those determined for "other cereals" (cereals other than maize)[7]. For cereal crops, the basic amount per tonne was raised from 25 ECU in 1993/94 to 45 ECU from 1995/96, while the cereal intervention price was reduced from 117 to 100 ECU in the same period. The basic amount of 65 ECU for protein crops was unchanged after 1993/94.

The next major reform affecting the sector was Agenda 2000[8], which took effect from 2000/01. This introduced further reductions in cereal intervention prices and increased the basic amounts paid per tonne of cereals. For protein crops, the same reform reduced the basic amount paid per tonne, which was based on the regional reference yield for "other cereals".

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[3] The focus of the measures to achieve a greater market orientation in Regulation 1251/1999 was the cereals sector (see Para (8) in its preamble), but the reform included protein crops in its scope.
[4] Para 24 in the preamble to Regulation 1872/2003
[5] Council Regulation (EEC) No 1765/92
[6] See Regulations 1765/92 and 1766/92. In Regulation 1782/2003 GAEC environmental standards with which producers had to comply to receive decoupled SPS payments expanded the scope of these requirements
[7] Described in Articles 3 and 6 of Council Regulation (EEC) No 1765/92 of 30 June 1992
[8] See Council Regulation (EC) No 1251/1999 of 17 May 1999.

The basic amount paid per tonne[9] was €72.50 for protein crops from 2000/01. For cereals, it was set at €58.67 per tonne in 2000/01, and rose to €63.00 from 2001/02. For oilseeds, which had their own system of area payments, a basic amount of €63.00 multiplied (as for protein crops) by the "other cereals" reference yield was applied from 2002/03. Thus, from 2002/03, protein crops received an area payment per hectare that exceeded the corresponding payment on "other cereal" and oilseed crops by €9.50 per tonne multiplied by the regional reference yield in tonnes per hectare.

The effect of the measures under the MacSharry and Agenda 2000 CAP reforms was to pay a basic amount of 78.49 ECU/€ per tonne (applying the switchover coefficient) as arable aids to protein crop producers from 1993/94 until 1999/2000, and then to lower the basic amount to €72.50 per tonne from 2000/01.

1.2. The CAP measures introduced in the 2003 CAP reform and their objectives

The 2003 reform[10], following the mid-term review of Agenda 2000, was designed to complete the shift from production support to producer support[11]. It stressed the need for (i) economic viability within the agricultural sector, which included enhancing its market orientation, by reducing the importance of coupled payments in favour of decoupled ones, in part to take account of the expectation of further WTO agreements on international trade reform; (ii) social balance, maintaining a role for direct payments while introducing compulsory (as opposed to the previous voluntary) modulation of such payments; (iii) environmental integration, entailing the integration of environmental goals into practice; (iv) economic and social cohesion, enhancing the role of the second pillar, namely rural development policy; and (v) the simplification of the implementation of the CAP measures.

A Single Payment Scheme (SPS) was introduced in the EU-15, with Member States given some discretion over the implementation date (end-2004, 2005 or 2006), as well as over the model adopted for the determination of the SPS payments to individual producers.

The reform emphasised cross-compliance conditions for the beneficiaries from the payments, and required Member States (abbreviated as MS) to introduce modulation, to achieve a better balance between policy tools designed to promote sustainable agriculture and those designed to promote rural development[12]. The funds thus obtained were used to fund the second pillar of rural development measures.

On their accession, the 12 new MS could opt for either a simplified Single Area Payment Scheme (SAPS) or the SPS. These 10 new MS (the exceptions were Malta and Slovenia) opted for the SAPS. Hungary will adopt the SPS in January 2010. The 12 new MS were also allowed to make Complementary National Direct Payments, on a coupled or decoupled basis, for specific crops, within national budgetary envelopes[13] (Table 2.1 lists the manner in which CNDPs were applied to protein crops).

For those Member States applying the SPS, the entire area payments on cereals (apart from special aids for durum wheat) and on oilseeds were included within the SPS payment per farm, unless the Member States opted to exercise their right to retain up to 25% of their coupled payments on COP crops, as France and Spain did. Table 2.1 summarises the schemes in effect today in each MS and their adoption dates.

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[9] Art 4(3) of Council Regulation (EC) No 1251/1999
[10] See Council Regulation (EC) No 1782/2003 of 29 September 2003.
[11] Paragraph (24) in the preamble to Regulation 1782/2003
[12] Paragraph (5) in the preamble to Regulation 1782/2003
[13] New MS applying SAPS, were permitted to grant CNDP under the conditions listed in Art. 143(c).

Table 2.1: Member States' choices of schemes for decoupled payments from 2005 (the Bulgarian and Romanian schemes took effect from 2007)

Member State/Region	Start Date (for SPS)	Model (SPS or SAPS)	Protein Crop Special Aids	Relevant Coupled National Payments
Belgium	2005	SPS historical	Yes	No
Bulgaria		SAPS	No	No. CNDP fully decoupled for protein
Czech Republic		SAPS	No	No. CNDP fully decoupled for protein
Denmark	2005	SPS dynamic hybrid	Yes	No
Germany	2005	SPS dynamic hybrid	Yes	No
Ireland	2005	SPS historical	Yes	No
Estonia		SAPS	No	Coupled CNDP for protein crops within arable envelope
Greece	2006	SPS historical	Yes	No
Spain	2006	SPS historical	Yes	25% coupled payments
France	2006	SPS historical	Yes	25% coupled payments
Italy	2005	SPS historical	Yes	No
Cyprus		SAPS	No	No. CNDP fully decoupled for protein
Latvia		SAPS	No	No. CNDP fully decoupled for protein
Lithuania		SAPS	No	Coupled CNDP for protein crops
Luxembourg	2005	SPS static hybrid	Yes	No
Hungary		SAPS	No	Coupled CNDP for protein crops within arable envelope
Malta	2007	SPS regional model	Yes	No
Netherlands	2006	SPS historical	Yes	No
Austria	2005	SPS historical	Yes	No
Poland		SAPS	No	No. CNDP fully decoupled for protein
Portugal	2005	SPS historical	Yes	No
Romania		SAPS	No	No. CNDP fully decoupled for protein
Slovenia	2007	SPS regional model	Yes	No
Slovakia		SAPS	No	No. CNDP fully decoupled for protein
Finland	2006	SPS dynamic hybrid	Yes	No
Sweden	2005	SPS static hybrid	Yes	No
UK - England	2005	SPS dynamic hybrid	Yes	No
UK - Scotland	2005	SPS historical	Yes	No
UK - Wales	2005	SPS historical	Yes	No
UK - Northern Ireland	2005	SPS static hybrid	Yes	No

Source: DG Agri

Notes: In 2005, Lithuania had CNDP coupled to protein crops. In Estonia, the CNDP for protein crops was included within a broader category containing arable crops, grain legumes and seeds, as well as protein crops, while in Poland CNDP was paid to all crops in Group 1, which included protein crops.

In 2006, the CNDP options for these four countries remained the same. Hungary started granting CNDP to protein crops, which were included in a larger group containing arable crops, grain legumes, seeds, durum wheat and hops).

In 2007, Poland moved to decoupled payments for the crops in Group 1. For all other four member states, payment options remained the same as 2006.

For protein crops, a special coupled aid was introduced in the form of a payment of €55.57 per hectare, subject to a Maximum Guaranteed Area[14], with *pro rata* reductions if the MGA is exceeded. The retention of a special aid for protein crops was intended to provide an incentive to increase the production of protein-rich crops[15]. The special aid is still tied to protein crop production and is not affected by the specific form of SPS selected by a Member State.

As a result of the reform, all protein crop farmers in the EU-15 MS receive this payment in full, irrespective of the regionalisation plans and reference yields that applied previously.

It has been stated[16] that the Commission determined the sum of €55.57, paid from 2005 onwards, by multiplying €9.50 per tonne (the difference between the basic amounts of €72.50 paid for protein crops and €63.00 paid for cereals) by the average "other cereals" reference yields in regions of protein crop output. This implies that the average reference yields in the regions producing protein crops was 5.85 tonnes per hectare (= €55.57 divided by €9.50).

The intended impact of the CAP measures introduced in the 2003 CAP reform that are specifically directed towards protein crops may be summarised as follows:

1.2.1. Provide an incentive to increase the production of protein-rich crops

By retaining special aids for protein crops, the current measures retain the primary objective, established in 1978, of supporting the role of protein-rich crops and increasing protein crop production, so as to reduce EU dependence upon imports of protein feeds[17].

In the 2003 reform, the only specific reference to the philosophy behind the new protein crop measures was included in the recital 36 to Council Regulation (EC) 1782/2003. This begins: "In order to strengthen the role of protein-rich crops and to provide an incentive to increase the production of these crops, it is appropriate to provide for a supplementary payment for farmers producing these crops".

The only other measures that provide specific payments for protein crops are those listed in Table 1.1. From the table, it may be seen that among the EU-15, only France and Spain have opted to retain 25% coupled payments within their SPS historical scheme.

Among the new Member States, the only specific payments that remain in effect for protein crops on their own are those that exist in Lithuania. Hungary and Estonia also provide payments within the CNDP scheme for protein crops. These payments, however, are included in the overall envelope for arable crops and, therefore, are not explicitly coupled.

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[14] The MGA was 1.4 million hectares before the first enlargement in 2004. It rose to 1.6 million hectares that year, and was increased to 1.648 million hectares after Bulgarian and Romanian accession in 2006.

[15] Paragraph (36) in the recitals to Regulation 1782/2003 states: "In order to strengthen the role of protein-rich crops and to provide an incentive to increase the production of these crops, it is appropriate to provide for a supplementary payment for farmers producing these crops. To ensure a correct application of the new scheme, certain conditions for entitlement to aid should be established. A maximum guaranteed area should be prescribed and proportional reductions applied if the maximum guaranteed area is exceeded."

[16] *EU Development of Protein Crops*, at COPA-COGECA Workshop 'Protein crops: what are the stakes for the European Union?', Brussels, 26/03/2008..

[17] In Council Regulation (EEC) No 1431/82, which introduced the first measures regarding the food uses of protein crops, it stated in the first paragraph of the preamble "Whereas the production of peas and field beans for animal feed is of increasing interest to the Community; whereas, to encourage the development of this production, which is subject to direct competition from oilcake imported duty free from outside the Community, it is necessary to continue providing for appropriate support measures"

1.2.2. Financial discipline

In order to ensure that the approved annual budgetary ceilings are not exceeded, a maximum guaranteed area was established. To avoid excessive incentives and over-production of such crops, the measures also included the following concluding sentences in the same recital: "To ensure a correct application of the new scheme, certain conditions for entitlement to aid should be established. A maximum guaranteed area should be prescribed and proportional reductions applied if the maximum guaranteed area is exceeded."

1.2.3. Ensure that aids are provided only for crops that have reached full maturity

In order to prevent special aids being granted for crops that might be used other than as a dried protein feed, such as their use in the production of silage, Article 77, Chapter 2 in Council Regulation (EC) 1782/2003 states that the aids will only be granted on "protein crops harvested after the stage of lactic ripeness".

1.2.4. Promoting the response to market signals, while providing income stability

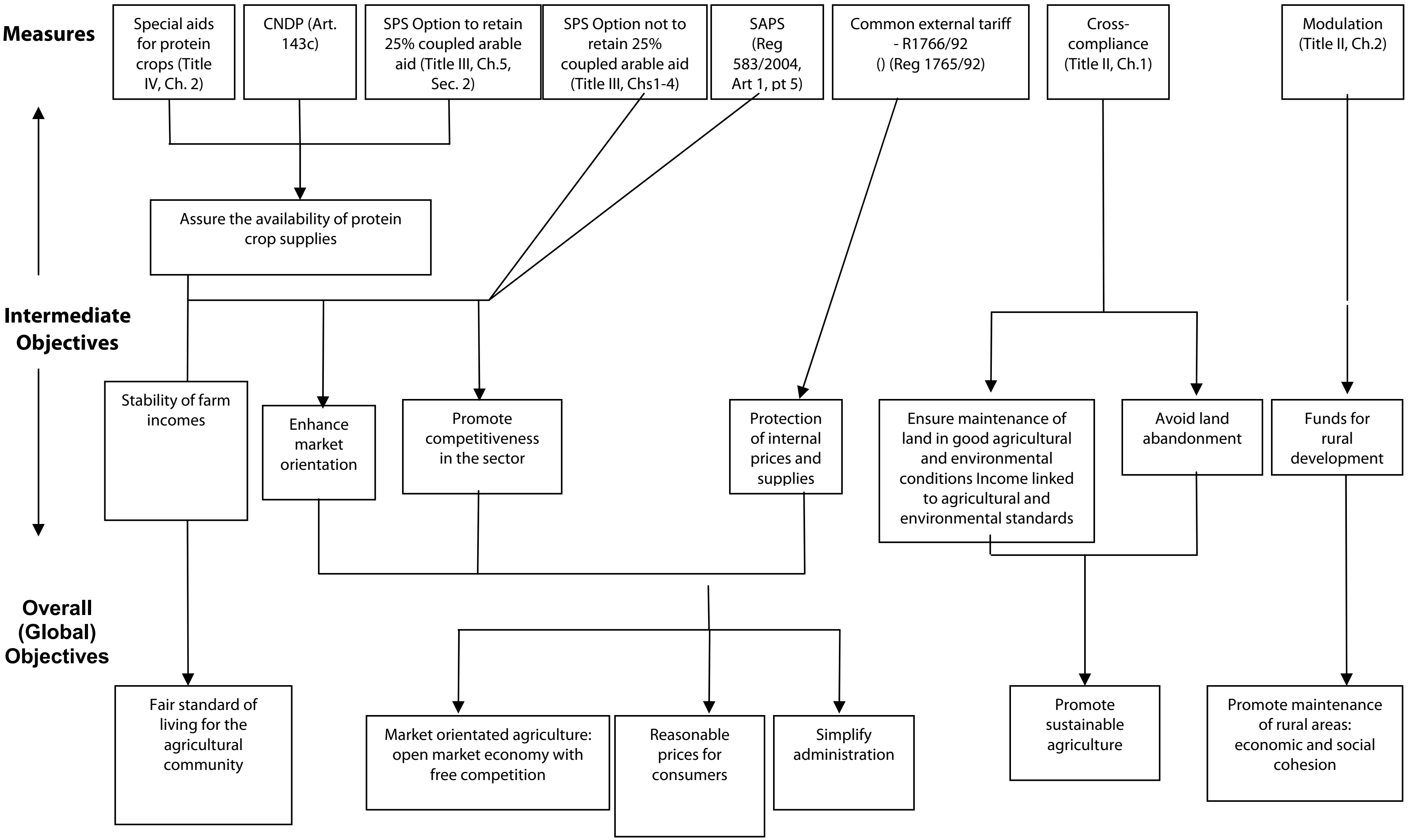
The full decoupling of area payment for cereals, and the partial decoupling of a major element of protein crop area payments, aimed to provide income support to farmers, while at the same ensuring that output was the result of a response to market signals.

The introduction of decoupled payments created a significant proportion of producers' incomes that is not exposed to volatility from yield and price fluctuations.

The Logical Diagram illustrates a comprehensive model of the intervention logic in the measures applied to the protein crop sector. This summarises the measures affecting the protein crop sector from 2003/04 to 2008/09.

It describes the key measures, their intermediate objectives and their global objectives, as set out in the Treaty establishing the European Community and in the 2003 Reform.

Logical Diagram: Framework for measures affecting the protein crop sector (referring to Council Reg. 1782/2003, unless otherwise stated)



1.3. The theoretical analysis of the measures applied in the protein crop sector

An important element of the 2003 CAP reform is a shift from coupled to decoupled measures. It is valuable, therefore, to review the theoretical analysis behind the concept of decoupling in the context of the protein crop sector[18].

There is no single definition of decoupling embraced by all academics and policy makers. However, in economic policy, it is widely accepted that decoupling is synonymous with having no, or minimal effect, on trade and production.

This definition is based on the use of the word in Annex II of the Uruguay Round Agreement on Agriculture (URAA). Article 6 of the same Annex establishes five criteria that decoupled income support measures are required to meet to be classified as "green box" measures. These are as follows:

(a) Eligibility for such payments shall be determined by clearly-defined criteria such as income, status as a producer or landowner, factor use or production level in a defined and fixed base period.

(b) The amount of such payments in any given year shall not be related to, or based on, the type or volume of production (including livestock units) undertaken by the producer in any year after the base period.

(c) The amount of such payments in any given year shall not be related to, or based on, the prices, domestic or international, applying to any production undertaken in any year after the base period.

(d) The amount of such payments in any given year shall not be related to, or based on, the factors of production employed in any year after the base period.

(e) No production shall be required in order to receive such payments.

An alternative definition of decoupling has been developed, based on the actual impact of measures on production and trade. Under this definition, applied in OECD studies, for example, measures are decoupled if they do not interfere with the level of output and trade.

Decoupling was introduced in the CAP measures within the 2003 reform[19]. In the CAP, the decoupling of income support provided to farmers under the SPS is intended to ensure that choice of crop or livestock will not be influenced by the decoupled aid received and that the farmers would respond to market signals when formulating their planting decisions

For protein crops, it was felt that in order to strengthen the role of these crops and to provide an incentive to increase their production, a special coupled aid was necessary. Consequently, the option of granting a special aid was retained under the 2003 reform, in addition to the SPS scheme.

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[18] This review draws upon the following sources: Lopez, J. A. (2001), Decoupling: a conceptual overview, OECD; Centre for Rural Economics Research, University of Cambridge (UK), (2003), CAP reform: decoupling arable payments; C. Cahill (2005) *op. cit)*; Andersson, F. CA (2004), Decoupling, the conceptual and past experiences, The Swedish Institute for Food and Agricultural Economics (SLI); OECD (2006), Decoupling: policy implications; Rude, J (2007), Production Effects of the European Union's Single Farm Payment, Department of Rural Economy, University of Alberta; and Johan Swinnen (2009), The Perfect Storm: The Political Economy of the Fischler Reforms of the Common Agricultural Policy, Centre for European Policy Studies, Brussels

[19] Recital 28 to Council Reg. EC 1782/2003 states "In order to leave farmers free to choose what to produce on their land, including products which are still under coupled support, thus increasing market orientation, the single payment should not be conditional on production of any specific product."

1.4. The health check

The latest reform, the Health Check[20], enacted in January 2009, establishes common rules for direct support schemes for farmers and envisages dismantling many of the remaining coupled payments and increasing the modulation of single farm payments.

For protein crops, the Health Check reform includes the provision that the uniform special aid of €55.57 per hectare will cease by 2012 in Member States applying the SPS (MS have the right to remove them sooner).

In addition, the choice by the French and Spanish governments to retain 25% of arable crop direct payments alongside 75% of SPS payments will disappear from 2010; however, under Article 68 in Chapter 5, Reg.73/2009, MS have some discretion in maintaining certain coupled aids for protein crops after 2012 under specific conditions.

Within the SPS system, modulation is being increased to 7% in 2009 and 10% in 2012 on payments of over €5,000, but a further 4% will be taken in modulation on payments in excess of €300,000.

Of relevance to the protein crop sector is the proposal that up to 10% of national ceilings for the SPS may be used for specific support in well defined cases, which Art. 68 states are:

(i) Specific types of farming which are important for the protection or enhancement of the environment;

(ii) Improving the quality of agricultural products;

(iii) Improving the marketing of agricultural products;

(iv) Practising enhanced animal welfare standards; and

(v) Specific agricultural activities entailing additional agri-environmental benefits.

1.5. The budgetary costs of CAP measures in the protein crop sector

Table 2.2 provides details of the distribution by Member State of the coupled budgetary costs of the CAP measures in the protein crop sector from 2000 to 2008.

It should be emphasised that the table excludes the budgetary costs of the partially coupled arable aids that were retained in France and Spain. It also excludes the budgetary costs associated with payments not explicitly linked to protein crops (such as CNDP schemes applied to broad categories of crops in Estonia, Hungary and Poland)

The table distinguishes between protein crop-producing Member States implementing the SPS scheme (the 16 listed from Austria to Slovenia) and those applying the SAPS (Lithuania).

A detailed description of protein crop–specific CNDP payments and CNDP payments benefiting protein crops, but not explicitly coupled to these crops, has already been presented in Table 2.1.

The sharp reduction in the total budgetary costs of coupled protein crop payments from €506.7 million in 2004 to €70.7 million in 2005 (€69.7 million as special aid and €1.0 million as coupled CNDP payments tied specifically to protein crop production) reflected the adoption of decoupled single farm payment systems, and the associated change in the coupled protein crop payments per hectare.

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[20] See Council Regulation (EC) No 73/2009 of 19 January 2009

The decline in protein crop output reduced the magnitude of the coupled budgetary cost of the special aids in countries applying the SPS to €42.6 million in 2008.

Table 2.2: The coupled budgetary costs of protein crop arable aids (prior to 2005) and special aids and coupled CNDP payments (from 2005) (€ million)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	17.94	16.62	15.56	16.87	17.10	2.33	2.15	2.01	1.74
Belgium	1.07	0.71	0.79	0.55	0.76	0.07	0.10	0.08	0.06
Germany	91.02	72.69	103.85	60.64	79.12	9.41	8.33	7.06	5.20
Denmark	27.95	18.04	17.52	20.68	15.92	1.88	1.15	0.71	0.46
Spain	13.42	14.52	17.16	39.24	48.13	10.82	11.63	9.85	9.06
Finland	1.50	2.22	2.14	1.92	1.64	0.30	0.26	0.31	0.34
France	253.35	213.91	218.15	197.57	208.92	24.61	22.62	17.08	11.35
UK	94.02	88.41	110.78	103.62	101.78	11.83	9.51	13.10	7.06
Greece	0.49	0.75	0.85	0.90	1.07	0.23	0.26	0.22	0.12
Ireland	1.28	-0.67	1.30	1.05	1.45	0.19	0.25	0.24	0.12
Italy	10.71	13.17	15.93	19.34	19.63	5.40	3.94	5.16	4.93
Luxembourg	0.16	0.13	0.20	0.18	0.16	0.02	0.02	0.02	0.02
Netherlands	0.60	0.46	0.65	0.79	1.31	0.15	0.12	0.04	0.03
Portugal	0.66	0.69	0.54	0.55	0.75	0.25	0.14	0.22	0.24
Sweden	10.21	7.99	9.33	9.94	8.97	2.16	2.27	2.09	1.79
Slovenia					0.00	0.00	0.02	0.04	0.04
Total	**524.37**	**449.62**	**514.74**	**473.84**	**506.71**	**69.66**	**62.77**	**58.20**	**42.56**
CNDP									
Lithuania						1.04	2.69	1.08	

Source: DG Agri..

Note: From 2005, these payments were made on the areas determined under Commission Regulation (EC) No 1973/2004 - Article 3(1) and as specified in Regulation 1782/03, Art.76. For earlier years, the payments of arable aids were as determined by Regulation (EEC) No 2316/99.

No data were available on the budgetary costs of Lithuania's CNDP payments in 2008.

Chapter 3: Overview of the Protein Crop Sector

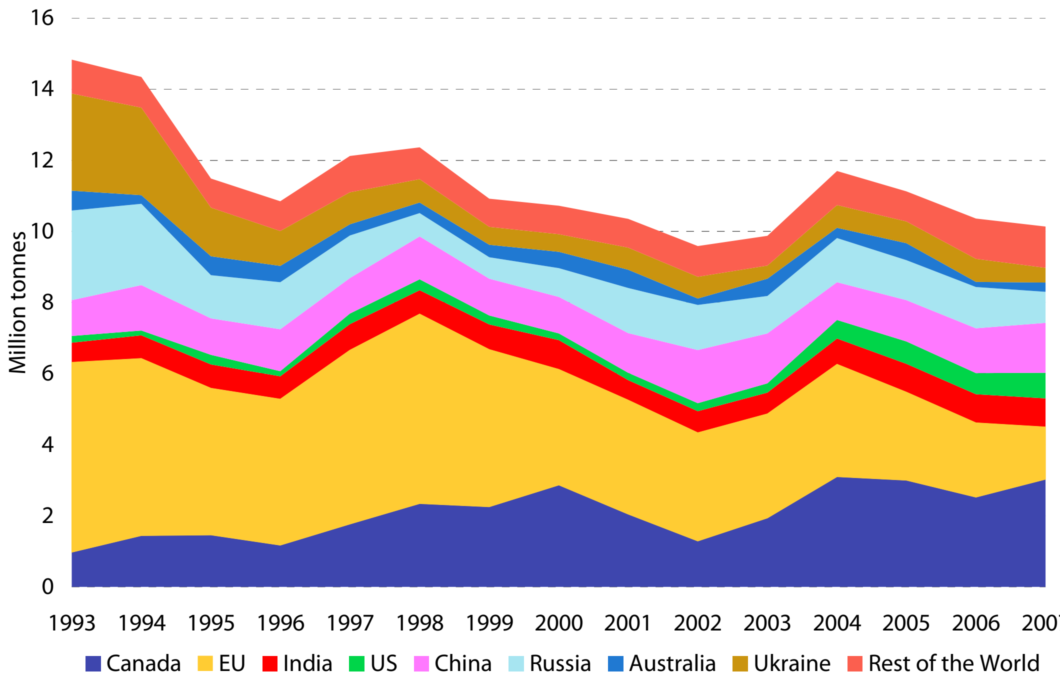
This chapter reviews the development of world and EU production, consumption and trade of the three protein crops covered by the CAP measures and how the EU share of world supply has evolved since the MacSharry reform[21]. It describes the special features of protein crop agronomy and discusses the structure of EU protein crop holdings. Finally, it presents trends in EU and world protein crop prices.

1. World production of protein crops

1.1. Field peas

The trend in world production of field peas[22] is depicted in Diagram 3.1, identifying the contribution of major producing countries. Field peas are the largest protein crop by output, with 64% of the combined total for the three crops in 2004-2007. This share has declined from one of 73% in 1993-1994, in part because world field pea output has fallen significantly since 1993. In 2007 it was 32% below the global level 14 years earlier.

Diagram 3.1: The composition of world output of field peas, 1993-2007



Sources: FAO, whose data refer throughout to the EU-27, and national data from MS

The EU, once the largest single producer, has experienced a major drop in its output, while most other producers have seen their output remain comparatively stable or, in the case of Canada, which is now the world's largest producer, grow significantly from 1993 to 2007[23].

1.2. Field beans

World output of field beans[24] has traced out a different path from that for field peas. Diagram 3.2 reveals that between 1993 and 2007 global production, led by the largest producer, China, rose by 26%. However, the world total was still only half that recorded for field peas in 2007. In 2007, China accounted for just under 50% of global output.

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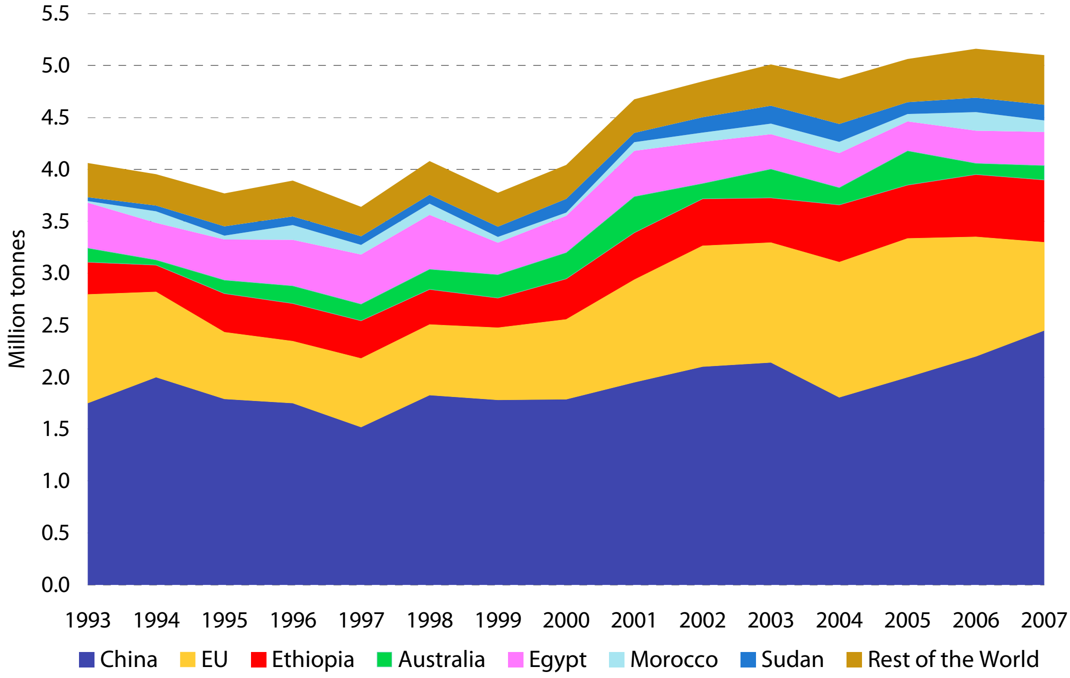
21 Regulation (EC) No 1765/92

22 FAO item code 187, *Pisum sativum*.

23 An Appendix has been prepared with a case study of the development of the Canadian field pea sector.

24 Field beans, described as broad beans and horse beans, *Vicia faba*, are covered by FAO item code 181.

Diagram 3.2: The composition of world output of field beans, 1993-2007

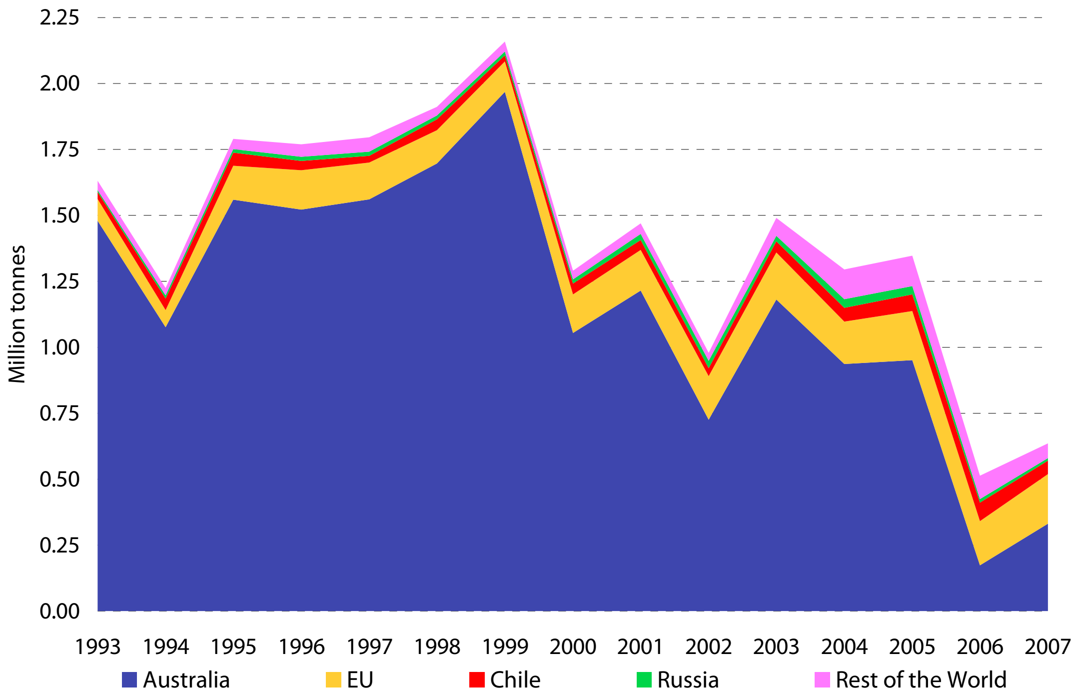


Source: FAO, and national data from MS

1.3. Sweet lupins

The global production of sweet lupins[25] has fallen sharply, as is evident from Diagram 3.3. This highlights the contributions of the leading producing countries.

Diagram 3.3: The composition of world output of sweet lupins, 1993-2007



Source: FAO, and national data from MS

[25] FAO item code 210, covering *Lupinus albus (saccharatus), Lupinus luteus*, and *Lupinus angustifolius*,.

From its peak in 1999 to 2007, world output tumbled by 71%. Australia, which has consistently been by far the largest producer worldwide, has led the decline, due in part to a series of droughts. Australian production fell by 83% in that eight year period, while EU output increased by 63%.

1.4. Combined output of the three protein crops

Diagram 3.4 illustrates the result of combining all three protein crops. Global output declined by 23% from 1993 to 2007, and only China and Canada among leading producers expanded significantly over this period. The EU and Australia recorded the largest declines. Because the individual protein crops displayed divergent movements in their global output volumes, the EU shares of the output of the individual protein crops have moved in different directions.

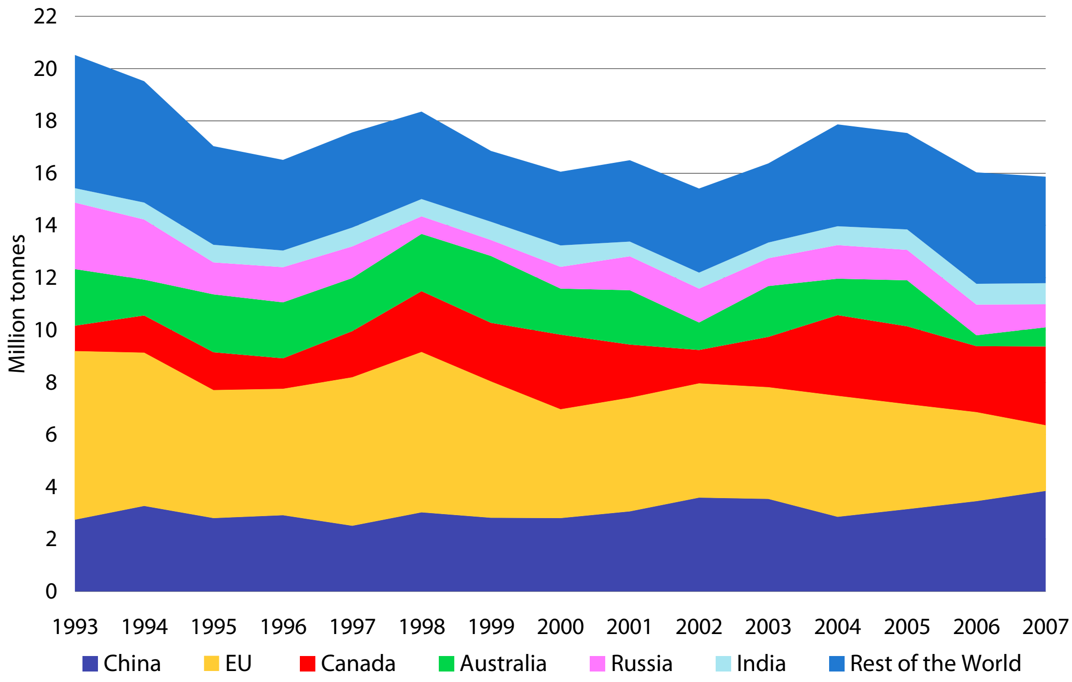
Diagram 3.5 plots the changes in the EU-27 proportion of the total world output of each crop from 1993 to 2007. For field peas, the EU share in 1996-1999 averaged 40%, in 2000-2003 it averaged 31% and in 2004-2007, its global market share averaged only 21%.

For field beans, the EU four year average share of worldwide supply rose steadily from 17% in 1996-1999 to 22% in 2000-2003 and 23% in 2004-2007.

The EU's share of world sweet lupin output rose from 7% in 1996-1999 to 13% in 2000-2003 and 22% in 2004-2007, but as Diagram 3.3 illustrated, Australia's decline was the major factor behind the increase in the EU's share.

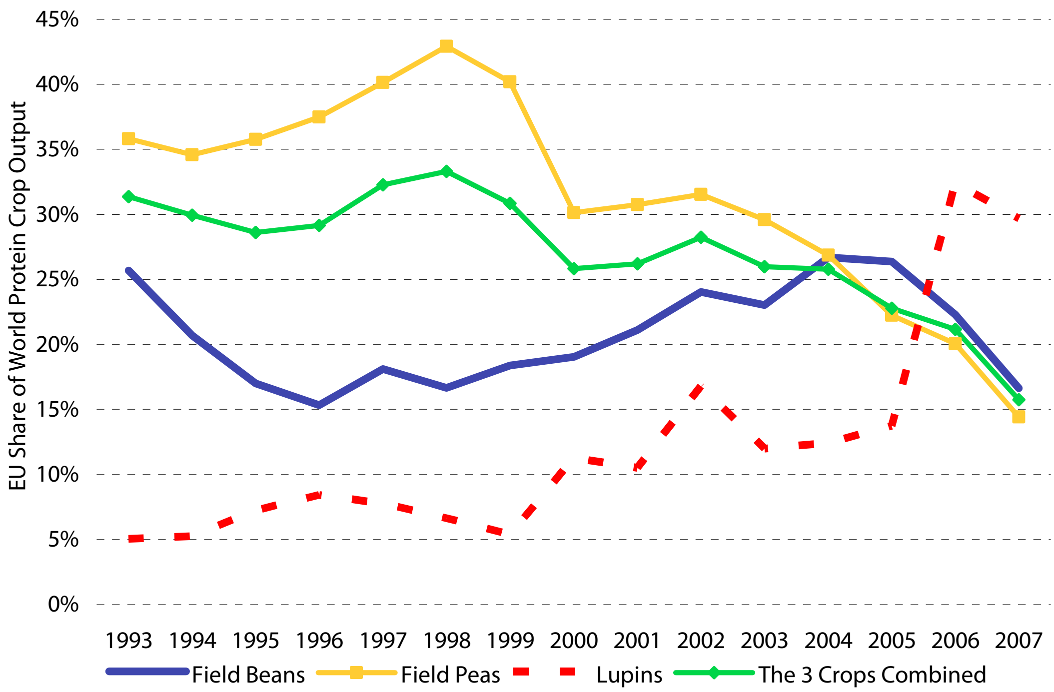
Where all three protein crops are combined, the EU share of world output dropped from 31% in 1996-1999 to 27% in 2000-2003 and 21% in 2004-2007.

Diagram 3.4: The composition of world output of the three protein crops, 1993-2007



Source: FAO, and national data from MS.

Diagram 3.5: The EU shares of world output of the three protein crops, 1993-2007



Source: Diagrams 3.1-3.4.

2. World areas and yields of protein crops

Diagram 3.6 plots the changes in planted areas under the three protein crops from 1993 to 2007. The axes are selected so that the EU values (measured on the left) are exactly 20% of the corresponding values for the Rest of the World (ROW, measured on the right hand axis), to make comparisons easy.

One observes that the EU area under field peas fell rapidly, while the Rest of the World's area recovered after an initial decline to be little changed over the full period.

For field beans, the Rest of the World area has been relatively stable, while that in the EU has been quite volatile, without a clear trend upwards or downwards.

For sweet lupins, the Rest of the World area has fallen substantially, while the EU area has been stable by comparison.

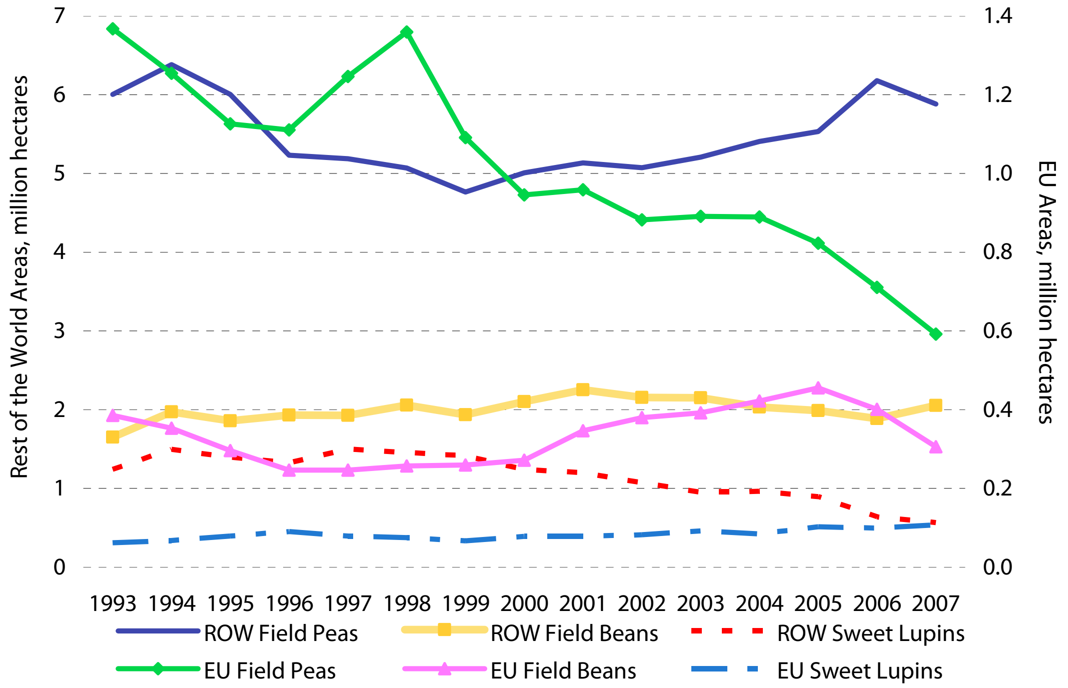
Diagram 3.7 contrasts yields per hectare in the EU-27 and the Rest of the World for the three protein crops. Apart from a very brief period in the early 1990s for sweet lupins, EU yields were always higher than those in the Rest of the World.

The trend in EU field pea yields has been downward since 1999, while that in the Rest of the World has fluctuated around a fairly flat trend, though it was relatively low in 2006 and 2007.

Trends in field bean yields in both the EU and Rest of the World were quite stable since 2000; however, the EU average yield is approximately double that recorded for Rest of the World.

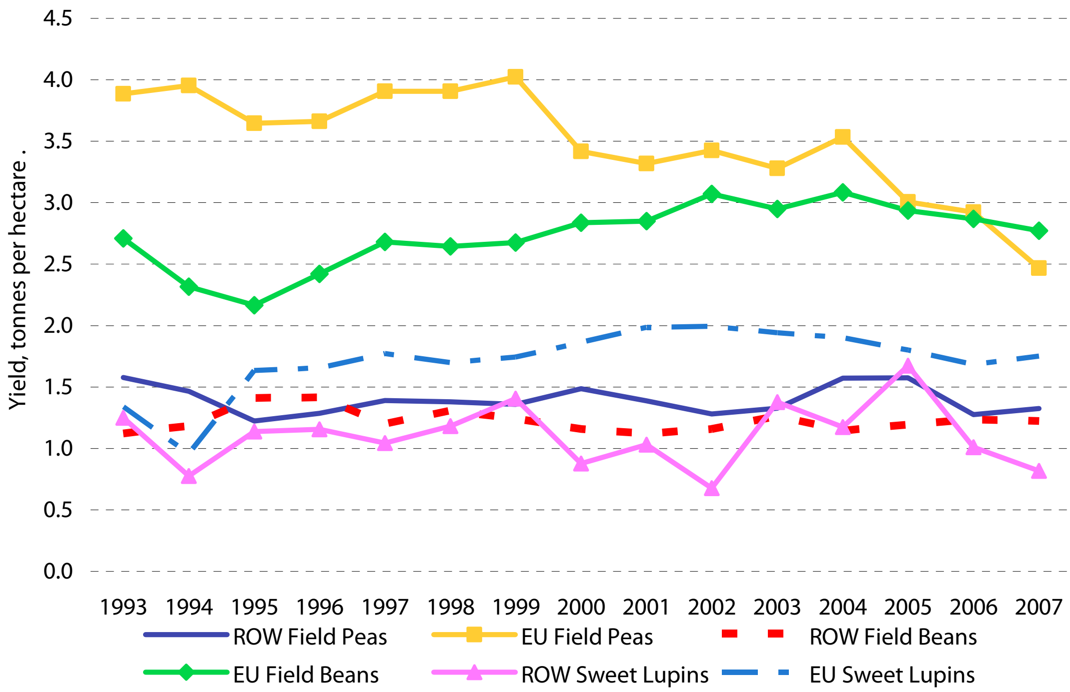
The trend in sweet lupin yields is reasonably flat for the EU. It displays much less instability than the recorded yields in the Rest of the World, which have been very sensitive to droughts in Australia, the world's leading producer.

Diagram 3.6: Areas planted to protein crops in the EU and Rest of the World, 1993-2007



Sources: FAO and national data from MS
Note: ROW = Rest of the World, i.e., excluding the EU-27

Diagram 3.7: Yields of protein crops in the EU and Rest of the World, 1993-2007



Sources: FAO and national data from MS
Note: ROW = Rest of the World, i.e., excluding the EU-27

3. EU area, production and yields of protein crops

In this section, we describe the development of Community production, areas and yields of the three protein crops covered by the CAP measures. The agronomy of protein crop cultivation is also described. The chapter continues by presenting the evolution of the supply and demand balance for protein crops. It concludes with an analysis of protein crop prices.

3.1. The development of EU protein crop areas

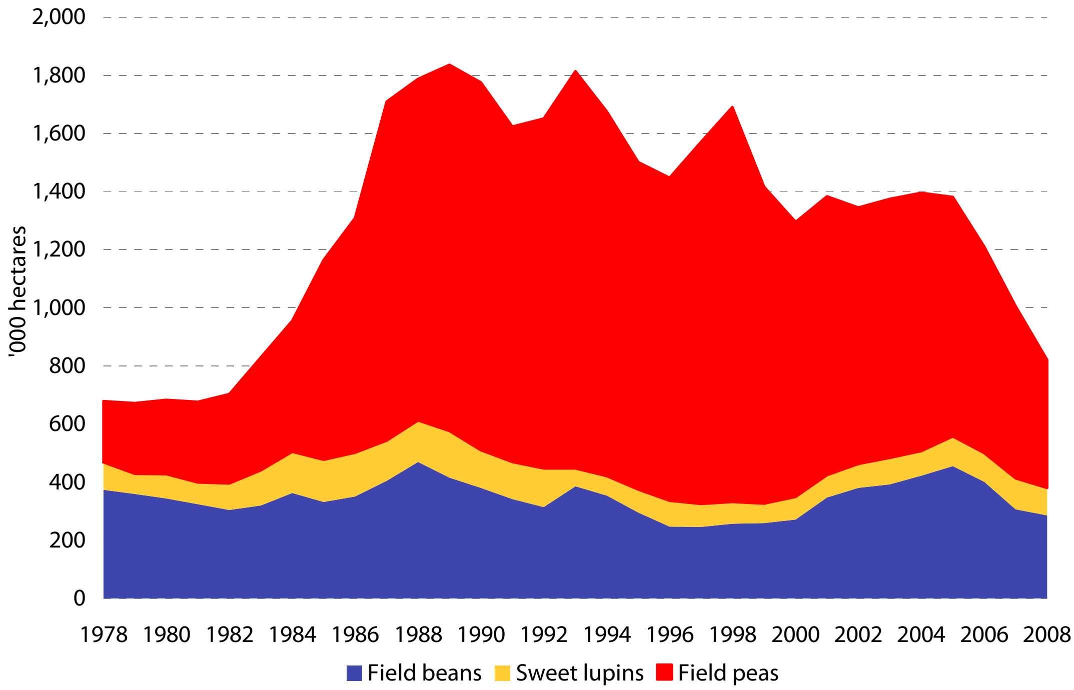
Chapter 2 noted that the first CAP measures in the protein crop sector were introduced in 1978. Diagram 3.8, plotting the areas planted to the three protein crops from 1978 to 2008, demonstrates that the measures to support protein crop production were very successful in the first decade of supports, which were based upon deficiency payments.

Diagram 3.8 indicates that the total area planted to protein crops almost trebled from the average level in the four year period, 1978-1981, when the area averaged 0.68 million hectares, to 1989, when it peaked at 1.84 million hectares.

The total area was again above 1.8 million hectares in 1993, and had a further temporary peak above 1.7 million hectares in 1998, but then declined to an average of 1.35 million hectares in 2000-2003, and 1.17 million in 2004-2008. In the three years, 2006-2008, after the full implementation of the SPS, the average total protein crop was 1.02 million hectares.

Over the last few years, protein crops have occupied a minor share of the total COP crop area in the Community. This share averaged 1.5% in 2006-2008. Tables 3.1-3.4 list the changes in areas under individual and total protein crops by MS from 2000 to 2007. (Prolea estimates provided data for total EU areas in 2008, but comprehensive data by MS are not yet available for 2008.)

Diagram 3.8: Total EU areas planted to protein crops, 1978-2008



Source: FAO, whose data refer throughout to the EU-27, supplemented by national data from individual MS and Prolea .

The expansion in areas was led by field peas. Its share rose from 31% of total EU-27 protein crop areas in 1978 to a maximum of 81% in 1998, but its share then declined to 68% in 2000-2003, 59% in 2004-2008 and 57% in 2006-2008, after the full implementation of SPS.

The preferred protein crop varies by region and by MS on account of differences in climate and soil quality, as well as in the seasonal demands upon farm labour for the main arable crops grown on the same farm. The benefits of nitrogen fixation differ somewhat between protein crops and in the ultimate beneficiary (whether it is the harvested protein crop itself or the following crop) from the nitrogen that is fixed by the crop[26].

However, one factor that has favoured plantings of field beans vis-à-vis plantings of field peas in recent years has been the development of erect field bean varieties, which facilitate harvesting, while varieties of field peas that are equally erect are not yet so widely available (though some exist). As a result, field peas have a tendency to become lodged, especially if the weather is wet at harvest time, and, as a result, a significant proportion of the crop may be left in the field. Also, field beans can be harvested later than field peas, which should be harvested before the pods split. This often creates a clash with winter wheat in North West Europe at harvest time.

Table 3.1: EU-27 field pea areas by Member State, 2000-2007 ('000 hectares)

	2000	2001	2002	2003	2004	2005	2006	2007
France	429.0	417.0	337.9	366.6	357.0	316.2	238.7	173.0
Germany	141.3	163.6	148.6	135.9	121.5	110.3	92.1	68.2
Spain	41.3	49.9	79.7	105.2	137.1	151.5	155.0	147.0
UK	84.0	96.0	82.0	68.0	59.0	50.0	40.0	34.0
Belgium-Luxembourg	1.8	2.1	1.8	2.2	2.1	1.7	1.3	1.5
Denmark	35.8	32.1	37.6	26.5	23.0	13.3	8.4	5.8
Greece	0.2	0.2	0.3	0.4	0.4	0.4	0.3	0.4
Italy	4.5	5.9	8.1	9.8	10.3	11.1	13.6	12.6
Ireland	0.5	0.5	0.5	1.0	1.0	1.0	1.0	0.9
Netherlands	1.2	1.5	1.7	2.9	2.7	2.3	1.1	1.5
Austria	41.1	38.6	41.6	42.1	39.3	36.0	32.7	28.1
Finland	5.2	5.4	5.1	4.1	2.7	3.7	4.2	4.4
Sweden	27.9	29.9	32.0	28.8	33.1	24.2	19.3	13.4
Poland	11.5	6.9	4.0	4.5	3.7	7.2	4.4	7.1
Hungary	25.5	26.4	22.5	22.5	21.7	19.9	20.1	22.3
Czech Republic	33.8	32.1	28.0	24.1	21.5	29.1	27.1	22.9
Estonia	3.2	3.2	2.2	4.0	4.2	4.3	4.5	4.9
Latvia	1.4	2.1	1.9	2.1	1.5	1.6	0.8	0.9
Lithuania	25.2	20.3	18.4	7.4	11.5	12.3	14.8	15.6
Slovakia	14.7	9.0	8.8	11.8	10.3	11.6	9.6	9.2
Slovenia	0.0	0.0	0.2	0.4	0.4	1.5	3.3	1.9
Bulgaria	3.5	4.1	4.1	2.3	1.8	1.4	0.6	0.7
Romania	13.1	11.7	14.8	18.1	23.6	12.2	17.5	18.7
Total	**945.6**	**958.7**	**881.8**	**890.7**	**889.5**	**823.0**	**710.6**	**594.9**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK)
Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

[26] *Nitrogen fixation*, M. Unkovich and A. McNeill, Western Australia Department of Agriculture and Food Crop Updates, 1998, revealed that field beans and sweet lupins accumulated more nitrogen per hectare than field peas in their experiments. However, three times as much of this nitrogen was taken from the field in harvested field beans as was the case for field peas, and twice as much nitrogen was taken in this manner for lupins as was taken for field peas. Therefore, the net fixation of nitrogen in the field after the harvest of the protein crop was similar for field peas and sweet lupins, but was roughly 40% lower for field beans.

Table 3.2: EU-27 field bean areas by Member State, 2000-2007 ('000 hectares)

	2000	2001	2002	2003	2004	2005	2006	2007
France	18.2	45.0	77.1	78.2	79.3	100.4	77.6	56.0
Germany	17.6	21.0	19.0	20.0	15.5	15.7	15.0	11.8
Spain	12.9	14.0	37.1	42.1	47.7	59.5	36.5	26.6
UK	122.0	173.0	161.0	160.0	191.0	182.0	181.0	116.0
Greece	2.6	2.3	2.4	2.1	1.9	1.8	1.8	3.1
Italy	47.8	46.9	41.4	44.1	44.1	48.5	44.6	51.6
Netherlands	0.7	0.7	0.5	0.6	0.5	0.4	0.5	0.5
Portugal	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.5
Austria	3.0	2.8	3.4	3.5	2.8	3.5	4.6	4.5
Poland	14.2	9.6	6.1	9.4	8.2	10.5	8.9	6.7
Hungary	3.9	2.9	2.9	2.3	1.2	1.2	0.8	0.6
Cyprus	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
Czech Republic	3.4	3.2	3.1	3.1	3.7	5.4	2.4	1.4
Malta	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Slovakia	0.2	0.2	1.0	1.2	0.8	0.8	2.7	1.8
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Bulgaria	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
Total	**271.5**	**346.5**	**379.9**	**391.7**	**421.8**	**454.9**	**401.2**	**305.9**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK); MAF (Malta)
Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

In 1978-80, after the first specific measures were introduced in the protein crop sector, field beans occupied over half the total protein crop area. Their share of the total area was 26% in 2000-2003, and rose to 32% in 2004-2008.

The sweet lupin share of the total area was 6% in 2000-2003 and 9% in 2004-2008. (It is important to note that these areas may include some land with mixed protein and cereal crops, since the special protein crop aid in the EU-15 are approved if the protein crops predominate in the mixture.)

Table 3.3: EU-27 sweet lupin areas by Member State, 2000-2007 ('000 hectares)

	2000	2001	2002	2003	2004	2005	2006	2007
France	11.1	12.6	13.5	11.1	8.9	7.2	6.6	5.0
Germany	23.6	30.5	36.2	45.6	35.8	38.6	32.8	33.0
Spain	15.4	12.4	17.5	13.8	15.6	13.7	9.7	6.0
UK	2.0	4.0	5.0	6.0	6.0	6.0	6.0	6.0
Greece	0.3	0.5	0.4	0.3	0.3	0.3	0.4	0.3
Italy	3.3	3.5	3.5	3.5	3.0	2.5	3.0	3.0
Portugal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Austria	0.0	0.0	0.0	0.2	0.2	0.3	0.5	0.4
Poland	18.9	12.2	4.5	8.9	11.6	28.9	25.4	41.9
Hungary	1.4	0.7	0.3	0.4	0.2	0.2	0.3	0.3
Latvia	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0
Lithuania	1.9	1.5	1.6	2.0	2.6	4.9	11.9	10.3
Slovakia	0.0	0.0	0.0	0.0	0.0	0.1	1.5	0.5
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8
Total	**78.0**	**77.8**	**82.4**	**92.0**	**84.5**	**102.7**	**98.9**	**107.6**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK)
Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

Table 3.4 : EU-27 total protein crop area by Member State, 2000-2007 ('000 hectares)

	2000	2001	2002	2003	2004	2005	2006	2007
France	458.3	474.6	428.4	456.0	445.3	423.8	323.0	234.0
Germany	182.6	215.2	203.9	201.6	172.8	164.6	139.9	113.0
Spain	69.6	76.3	134.2	161.2	200.3	224.7	201.2	179.6
UK	208.0	273.0	248.0	234.0	256.0	238.0	227.0	156.0
Belgium-Luxembourg	1.8	2.1	1.8	2.2	2.1	1.7	1.3	1.5
Denmark	35.8	32.1	37.6	26.5	23.0	13.3	8.4	5.8
Greece	3.1	3.0	3.1	2.8	2.6	2.6	2.5	3.8
Italy	55.6	56.4	53.0	57.4	57.5	62.2	61.2	67.1
Ireland	0.5	0.5	0.5	1.0	1.0	1.0	1.0	0.9
Netherlands	1.9	2.2	2.2	3.5	3.2	2.8	1.6	2.0
Portugal	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.5
Austria	44.1	41.4	45.0	45.8	42.4	39.9	37.7	33.0
Finland	5.2	5.4	5.1	4.1	2.7	3.7	4.2	4.4
Sweden	27.9	29.9	32.0	28.8	33.1	24.2	19.3	13.4
Poland	44.6	28.7	14.6	22.9	23.5	46.5	38.6	55.7
Hungary	30.8	29.9	25.7	25.2	23.1	21.3	21.3	23.2
Cyprus	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
Czech Republic	37.2	35.3	31.1	27.2	25.2	34.5	29.5	24.3
Estonia	3.2	3.2	2.2	4.0	4.2	4.3	4.5	4.9
Latvia	1.4	2.1	1.9	2.2	1.7	1.6	0.8	0.9
Lithuania	27.1	21.8	20.0	9.4	14.1	17.2	26.7	25.9
Malta	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Slovakia	14.9	9.2	9.8	13.0	11.1	12.5	13.8	11.5
Slovenia	0.0	0.0	0.2	0.4	0.4	1.5	3.4	2.0
Bulgaria	3.8	4.4	4.4	2.6	2.1	1.7	1.4	1.5
Romania	13.1	11.7	14.8	18.1	23.6	12.2	17.5	18.7
Total	**1,295.1**	**1,383.0**	**1,344.2**	**1,374.3**	**1,395.8**	**1,380.6**	**1,210.6**	**1,008.4**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK); MAF (Malta)
Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

3.2. The development of EU protein crop yields

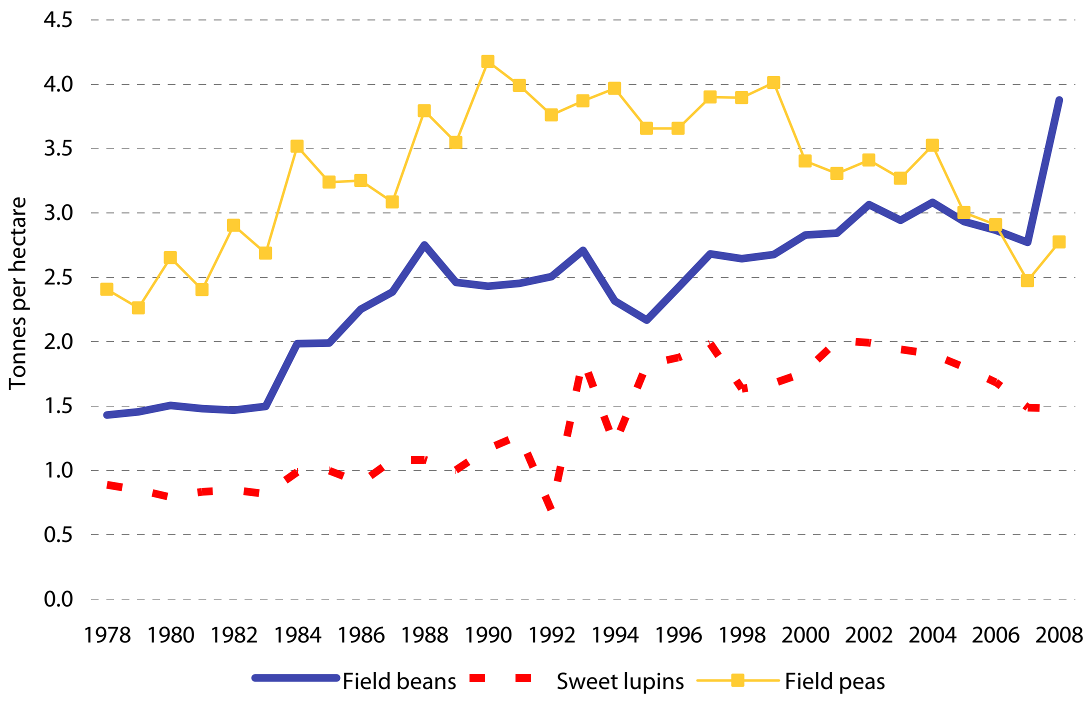
The EU protein crop sector has experienced mixed fortunes regarding its trend in yields. Protein crop yields depend on several external factors beyond a farmer's control, such as weather, pests and disease, which can result in considerable fluctuations in yields over time. This was apparent from Diagram 3.7. This demonstrated that fluctuations in yields also affected other important producing countries outside the EU.

Diagram 3.9 plots EU protein crop yields over the period 1978-2008. Until 2007, field peas recorded the highest yields per hectare among the three crops, but whereas the underlying trends for field beans and sweet lupins were upwards over the entire 30 year period, field pea yields peaked in 1990, before falling back sharply, with the decline starting in 1999.

The decline in average field pea yields had two components: one was the changing shares of Community production in individual Member States, with sharp decreases in the percentage of EU areas in MS such as France, which typically record high yields, and increases in the relative importance of MS with lower than average yields, notably Spain. The other important factor behind the fall in average field pea yields in the EU as a whole was the decline in yields recorded in France, which is the Community's most important single producer of this crop.

The evolution of yields by type of protein crop and MS is presented in Tables 3.5 to 3.8. These cover 2000-2007, and reveal that yields fluctuated a great deal in some MS. This is primarily linked to climatic problems during planting and harvesting. The incidence in field peas of the *aphanomyces* fungus was identified in interviews as a growing problem in the case of France.

Diagram 3.9: Average EU yields of the three protein crops, 1978-2008



Source: FAO; ;Prolea (France); ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK)

Table 3.5: EU-27 field pea yields by Member State (tonnes per hectare)

	2000	2001	2002	2003	2004	2005	2006	2007
France	4.5	4.0	4.9	4.4	4.7	4.2	4.2	3.7
Germany	2.9	3.4	2.8	2.9	3.8	3.1	3.1	2.9
Spain	1.4	1.0	1.3	1.4	1.5	0.9	1.3	1.1
UK	3.0	3.3	3.2	3.7	3.0	3.1	3.1	2.4
Belgium-Luxembourg	3.9	4.0	3.6	4.7	3.6	3.4	3.3	3.1
Denmark	3.8	3.5	3.7	4.0	3.6	3.2	3.1	3.3
Greece	2.0	1.8	1.7	1.2	3.3	3.1	1.8	1.5
Italy	2.7	3.1	3.1	3.0	3.1	3.1	3.1	3.0
Ireland	3.4	3.8	4.0	4.7	4.5	5.0	4.0	4.2
Netherlands	5.0	4.7	4.1	3.4	4.0	4.2	4.4	4.0
Austria	2.3	2.9	2.2	2.2	3.1	2.5	2.8	2.0
Finland	2.3	2.1	2.2	2.5	2.1	2.2	2.1	2.4
Sweden	2.4	2.5	2.6	2.7	2.7	2.7	2.6	2.8
Poland	1.5	1.6	1.9	1.6	2.2	1.6	1.5	1.7
Hungary	1.9	2.4	2.2	1.3	3.0	2.5	2.4	2.3
Czech Republic	2.2	2.6	2.0	2.2	3.3	2.7	2.6	2.5
Estonia	1.7	1.6	2.2	1.2	0.8	1.3	1.2	1.9
Latvia	2.1	1.2	1.7	1.8	1.8	1.6	1.0	2.0
Lithuania	2.0	1.5	2.0	2.9	1.9	1.7	1.1	1.6
Slovakia	1.2	2.6	2.9	1.6	3.1	2.4	2.4	1.8
Slovenia	2.7	2.9	3.4	1.7	2.9	3.0	3.0	2.1
Bulgaria	1.5	2.1	2.2	1.7	2.6	1.7	1.9	6.0
Romania	1.1	1.9	1.4	1.3	2.4	3.2	2.0	0.9
Total	**3.4**	**3.3**	**3.4**	**3.3**	**3.5**	**3.0**	**2.9**	**2.5**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK)

Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

Table 3.6: EU-27 field bean yields by Member State (tonnes per hectare)

	2000	2001	2002	2003	2004	2005	2006	2007
France	3.8	3.5	4.0	3.5	4.6	3.7	3.7	4.3
Germany	3.5	3.9	3.4	3.0	4.1	3.8	3.3	3.2
Spain	1.1	1.1	1.1	1.2	1.4	0.7	1.3	1.5
UK	4.0	3.5	3.9	4.0	3.5	3.9	3.4	3.2
Greece	1.9	1.7	1.7	1.4	1.6	1.7	1.7	1.8
Italy	1.5	1.5	1.5	1.5	1.9	1.8	1.9	1.9
Netherlands	5.7	6.3	5.9	4.6	6.6	6.4	5.3	5.0
Portugal	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7
Austria	2.4	2.7	2.6	2.7	2.7	2.9	2.7	2.2
Poland	2.0	2.0	2.2	2.4	2.8	2.4	2.0	2.3
Hungary	0.7	0.8	0.8	1.1	1.5	1.9	1.9	1.9
Cyprus	1.0	0.9	1.0	1.0	0.8	0.8	0.7	0.8
Czech Republic	1.3	1.3	1.4	1.4	2.2	1.6	1.4	1.2
Malta	2.7	2.7	2.6	2.7	2.7	2.7	2.6	2.9
Slovakia	1.4	1.7	1.5	1.1	1.8	1.9	1.2	0.8
Slovenia				0.7	2.0	1.3	0.3	0.3
Bulgaria	0.3	1.0	1.0	1.0	1.3	0.8		
Total	**2.8**	**2.8**	**3.1**	**2.9**	**3.1**	**2.9**	**2.9**	**2.8**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK); MAF (Malta)

Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

Table 3.7: EU-27 sweet lupin yields by Member State (tonnes per hectare)

	2000	2001	2002	2003	2004	2005	2006	2007
France	3.0	2.7	2.6	2.2	2.5	2.5	2.5	2.6
Germany	2.5	2.5	2.5	2.4	2.5	2.5	2.6	2.6
Spain	0.8	0.6	0.7	0.7	0.7	0.4	0.7	0.9
UK	3.1	2.7	2.6	2.4	1.9	2.6	2.3	1.9
Greece	1.0	1.0	1.1	1.5	1.0	1.0	1.3	1.3
Italy	1.5	1.4	1.3	1.4	1.5	1.4	1.8	1.7
Portugal	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Austria				3.0	3.0	3.0	3.0	3.0
Poland	1.4	1.4	1.5	1.3	1.6	1.4	1.1	1.3
Hungary	0.7	1.0	0.9	0.7	1.1	1.9	1.9	1.8
Latvia				1.0	0.1	5.7		
Lithuania	0.9	1.0	1.1	1.4	1.1	1.0	0.4	0.8
Slovakia						1.0	1.3	0.6
Bulgaria							2.1	2.1
Total	**1.9**	**2.0**	**2.0**	**1.9**	**1.9**	**1.8**	**1.7**	**1.8**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK)

Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

Table 3.8 EU-27 overall protein crop yields by Member State (tonnes per hectare)

	2000	2001	2002	2003	2004	2005	2006	2007
France	4.5	3.9	4.7	4.2	4.6	4.1	4.1	3.8
Germany	2.9	3.3	2.8	2.8	3.6	3.0	3.0	2.9
Spain	1.2	1.0	1.1	1.3	1.4	0.8	1.3	1.2
UK	3.6	3.4	3.7	3.9	3.3	3.7	3.3	3.0
Belgium-Luxembourg	3.9	4.0	3.6	4.7	3.6	3.4	3.3	3.1
Denmark	3.8	3.5	3.7	4.0	3.6	3.2	3.1	3.3
Greece	1.8	1.6	1.6	1.4	1.8	1.8	1.7	1.7
Italy	1.6	1.6	1.8	1.7	2.1	2.0	2.1	2.1
Republic of Ireland	3.4	3.8	4.0	4.7	4.5	5.0	4.0	4.2
Netherlands	5.3	5.2	4.5	3.6	4.4	4.6	4.6	4.3
Portugal	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7
Austria	2.4	2.9	2.3	2.3	3.1	2.5	2.8	2.1
Finland	2.3	2.1	2.2	2.5	2.1	2.2	2.1	2.4
Sweden	2.4	2.5	2.6	2.7	2.7	2.7	2.6	2.8
Poland	1.6	1.6	1.9	1.8	2.1	1.7	1.4	1.5
Hungary	1.7	2.2	2.0	1.3	2.9	2.5	2.4	2.3
Cyprus	1.0	0.9	1.0	1.0	0.8	0.8	0.7	0.8
Czech Republic	2.1	2.5	1.9	2.1	3.2	2.5	2.5	2.4
Estonia	1.7	1.6	2.2	1.2	0.8	1.3	1.2	1.9
Latvia	2.1	1.2	1.7	1.8	1.6	1.6	1.0	2.0
Lithuania	1.9	1.4	1.9	2.6	1.8	1.5	0.8	1.2
Malta	2.7	2.7	2.6	2.7	2.7	2.7	2.6	2.9
Slovakia	1.2	2.5	2.7	1.6	3.0	2.4	2.0	1.6
Slovenia	2.7	2.9	3.4	1.7	2.9	3.0	2.9	2.1
Bulgaria	1.4	2.0	2.1	1.6	2.4	1.6	2.0	3.9
Romania	1.1	1.9	1.4	1.3	2.4	3.2	2.0	0.9
Total	**3.2**	**3.1**	**3.2**	**3.1**	**3.3**	**2.9**	**2.8**	**2.5**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK)
Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

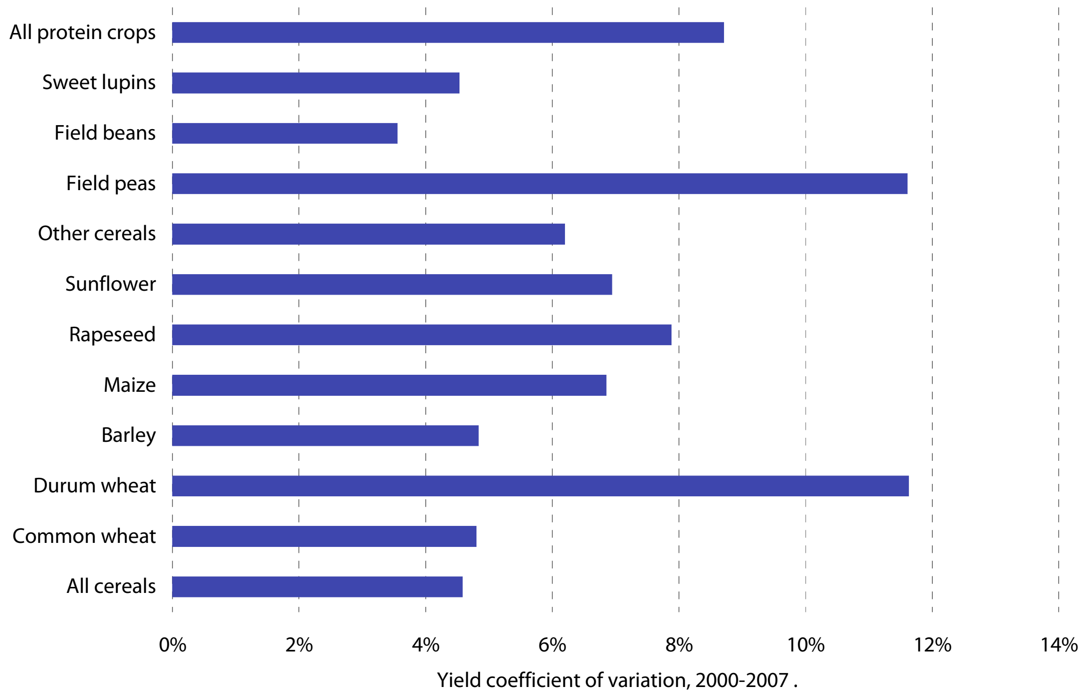
3.2.1. Coefficient of variation of protein crop yields vis-à-vis other COP crops

An important aspect of producers' choice of crops, revealed during interviews for the case study monographs, is the commonly expressed view that protein crops, and principally field peas, are riskier in their yields than alternative COP crops. Diagram 3.10 compares the volatility of protein crop yields with that of competing crops in the EU-15 from 2000 to 2007 (the latest year for which final yields are known by MS). The comparison has been made only for EU-15 MS because comprehensive yield data for all COP crops in the EU-12 could not be obtained on a consistent basis in the full period prior to their accession.

The measure used to assess risk is the coefficient of variation of annual yields for the period 2000-2007 (the coefficient of variation is defined as the standard deviation of the annual yields divided by the mean value). A high coefficient of variation is interpreted to be synonymous with a high level of yield volatility and risk and a low coefficient is interpreted as an indication of a low risk in the realised level of yields. Diagram 3.10 reveals that, over the period since 2000, the coefficient of variation was highest for field pea and durum wheat yields. In contrast, the volatility of field bean yields was the lowest among the major COP crops included in the comparison, while sweet lupins had the second lowest volatility of yields among the individual COP crops compared in the diagram.

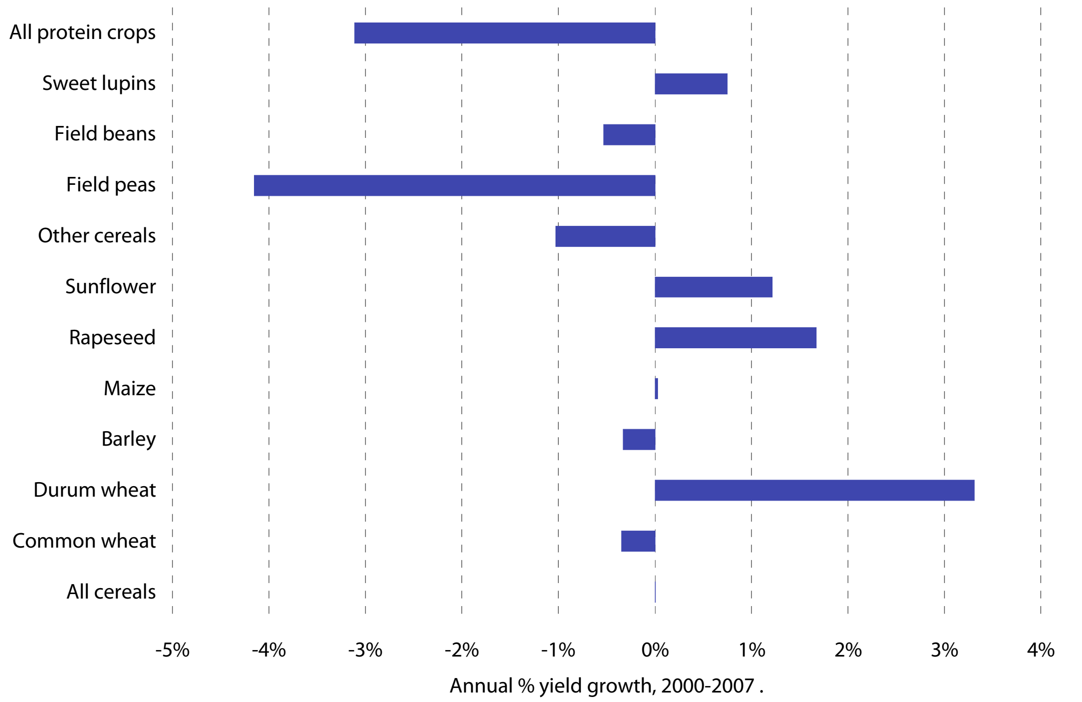
This analysis confirms that, over the observed period, field peas are riskier than other crops in their yields, which may be one factor behind the decline observed in field pea areas. The analysis also provides a possible reason for the stronger performance of field beans and sweet lupins in their trends in areas since the 2003 reform. Risk-averse producers appear to be justified in favouring these crops over field peas, on the grounds of their greater yield stability.

Diagram 3.10: Coefficient of variation of EU-15 COP crop yields, 2000-2007



Source: DG Agri, FAO

Diagram 3.11: EU-15, yield growth rates for protein and other arable crops, 2000-07



Sources: DG Agri; FAO
Note: The yield trends are obtained by fitting an exponential trend to the annual yield data.

3.2.2. Growth rates of protein crop yields vis-à-vis other COP crops

In Diagram 3.11, we assess the average growth rates in the yields of protein crops and contrast these with the corresponding growth rates of the leading COP crops in the EU-15.

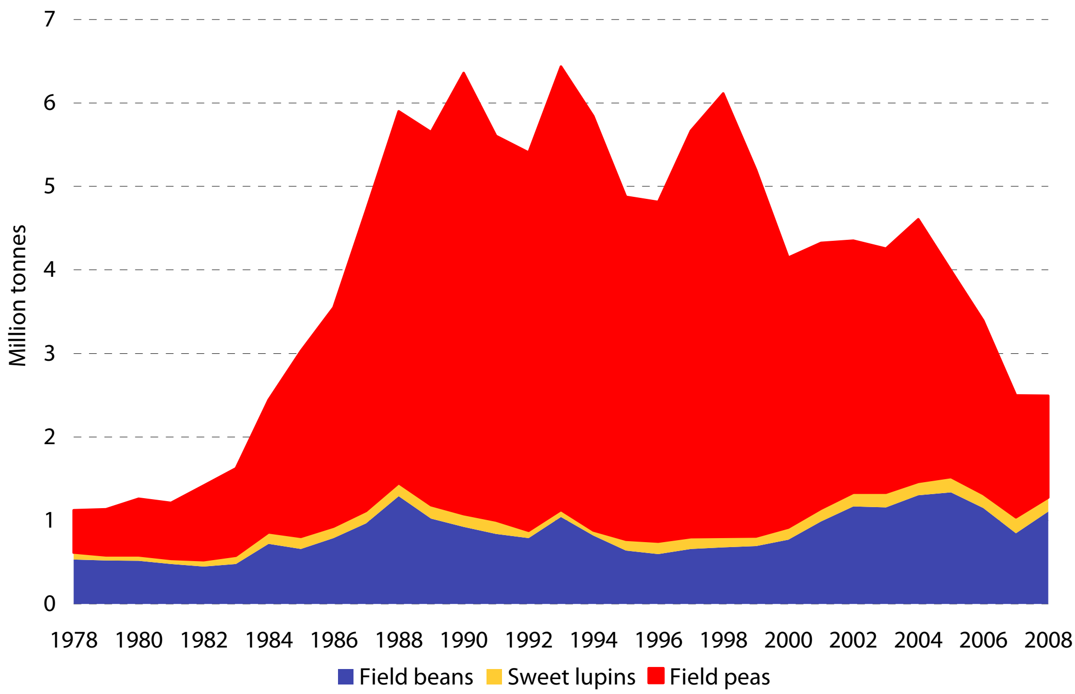
This analysis is limited to this group of countries because of the absence of fully consistent data for the New MS over the full period. There is clear evidence from this comparison that, for protein crops as a whole, the average yearly change in Community-wide average yields has been significantly worse than that for other COP crops. This outcome is mainly the result of the large negative growth rate experienced by field peas, the largest protein crop in terms of area within the EU-15. Field beans also recorded a negative growth rate in their yields over this period. For sweet lupins, the average annual yield growth rate was positive.

Among the other COP crops, the "other cereals" (i.e., mainly rye, oats and triticale) had a worse yield trend than field beans, but all the other main cereal crops, as well as the two main oilseed crops, recorded better yield trends than both of the main protein crops.

3.3. The development of EU protein crop production

Because of the importance of field peas in the sector and the decline in field pea yields in recent years, total output of the three crops, depicted in Diagram 3.12, has fallen somewhat faster than the planted areas since 2000. Data by MS are provided in Tables 3.9-3.12.

Diagram 3.12: Total EU Production of Protein Crops, 1978-2008



Source: FAO, supplemented by data from agriculture ministries in Germany, Poland and the UK.

Total protein crop output rose significantly between 1978 and 1988, from around 1.1 million tonnes to just below six million tonnes. This expansion was driven by a significant increase in field pea production, which, in 1988, accounted for around 75% of the protein crop total.

Over the decade 1989-1998, protein crop output averaged around 5.7 million tonnes, reaching a peak of 6.5 million tonnes in 1993. Production declined sharply between 1998 and 2000, falling by around two million tonnes, due to a collapse in field pea production. Output then remained comparatively stable from 2001 to 2005, at around 4.3 million tonnes, with the individual protein crops witnessing different dynamics.

Table 3.9: EU-27 field pea production by Member State, 2000-2007 ('000 tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007
France	1,936.5	1,660.0	1,662.6	1,616.7	1,680.8	1,331.3	1,009.6	643.0
Germany	408.9	559.6	413.2	391.7	464.2	346.3	287.7	200.0
Spain	58.2	51.6	100.2	148.2	201.2	132.5	206.9	163.9
UK	251.0	314.0	262.0	254.0	176.0	156.0	122.0	80.0
Belgium-Luxembourg	7.1	8.4	6.7	10.4	7.6	5.7	4.3	4.6
Denmark	137.0	111.4	139.4	105.6	83.3	43.2	26.2	19.4
Greece	0.4	0.4	0.5	0.5	1.3	1.4	0.6	0.6
Italy	12.1	18.3	25.3	29.6	32.5	34.5	42.7	38.1
Ireland	1.7	1.9	2.0	4.7	4.5	5.0	4.0	3.8
Netherlands	6.0	7.0	7.0	10.0	10.7	9.8	4.6	6.0
Austria	96.5	112.4	93.3	93.1	122.1	90.3	89.9	56.7
Finland	11.7	11.5	11.1	10.2	5.6	8.1	8.8	10.7
Sweden	67.4	76.3	84.4	79.1	88.0	65.4	50.8	38.1
Poland	17.6	10.8	7.5	7.1	8.1	11.7	6.6	12.0
Hungary	47.6	64.1	49.4	30.2	64.4	50.2	49.3	51.0
Czech Republic	75.3	82.5	56.1	53.7	72.0	78.8	71.5	57.6
Estonia	5.3	5.0	4.8	4.8	3.2	5.7	5.5	9.4
Latvia	3.0	2.6	3.3	3.8	2.7	2.5	0.8	1.8
Lithuania	49.7	30.0	37.0	21.6	22.0	21.1	15.8	24.2
Slovakia	18.2	23.0	25.1	19.1	31.4	28.2	22.8	16.4
Slovenia	0.0	0.1	0.7	0.6	1.2	4.6	9.9	4.1
Bulgaria	5.2	8.7	8.9	3.8	4.8	2.4	1.1	4.2
Romania	14.2	21.7	20.5	23.5	57.0	38.8	35.7	16.6
Total	**3,230.6**	**3,181.4**	**3,021.0**	**2,922.1**	**3,144.4**	**2,473.4**	**2,077.2**	**1,462.1**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK);
Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

Table 3.10: EU-27 field bean production by Member State, 2000-2007 ('000 tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007
France	69.7	158.0	310.4	276.3	364.5	372.2	290.5	242.0
Germany	62.0	81.0	65.0	60.8	64.1	59.6	49.1	38.0
Spain	14.0	14.9	41.6	51.6	64.4	40.6	48.8	38.6
UK	485.0	606.0	632.0	639.0	661.0	705.0	617.0	375.0
Greece	5.0	4.0	4.0	3.0	3.1	3.0	3.1	5.6
Italy	71.7	69.1	63.8	64.8	82.0	86.9	82.6	97.1
Netherlands	4.0	4.4	2.9	2.8	3.4	2.8	2.7	2.5
Portugal	15.0	15.0	15.0	15.0	15.0	16.5	17.5	18.0
Austria	7.1	7.4	8.9	9.3	7.8	10.2	12.3	10.1
Poland	28.1	19.3	13.2	22.7	23.1	24.8	17.6	15.6
Hungary	2.7	2.3	2.3	2.5	1.8	2.2	1.5	1.1
Cyprus	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.4
Czech Republic	4.4	4.2	4.3	4.2	8.2	8.5	3.2	1.7
Malta	0.8	0.7	0.7	0.7	0.8	0.8	0.7	0.8
Slovakia	0.3	0.3	1.5	1.3	1.4	1.6	3.3	1.5
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bulgaria	0.1	0.3	0.3	0.3	0.4	0.3	0.0	0.0
Total	**770.2**	**987.3**	**1,166.4**	**1,154.7**	**1,301.2**	**1,335.5**	**1,150.2**	**848.0**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK); MAF (Malta)
Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

Table 3.11: EU-27 sweet lupin production by Member State, 2000-2007 ('000 tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007
France	33.6	34.5	35.3	24.0	22.0	17.6	16.6	13.0
Germany	59.3	76.7	90.9	110.0	90.0	95.0	85.0	85.0
Spain	12.5	7.9	11.8	9.5	10.2	5.6	6.9	5.2
UK	6.3	11.0	12.8	14.7	11.1	15.4	13.7	11.7
Greece	0.3	0.5	0.5	0.5	0.3	0.3	0.5	0.4
Italy	4.8	4.8	4.6	5.0	4.6	3.5	5.5	5.0
Portugal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Austria	0.0	0.0	0.0	0.6	0.6	1.0	1.4	1.3
Poland	26.0	17.0	6.5	11.2	19.0	40.9	28.0	56.5
Hungary	1.0	0.7	0.2	0.3	0.2	0.4	0.6	0.6
Latvia	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Lithuania	1.7	1.5	1.7	2.8	2.8	4.9	4.8	7.9
Slovakia	0.0	0.0	0.0	0.0	0.0	0.1	1.9	0.3
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0	1.7	1.7
Total	**145.5**	**154.4**	**164.3**	**178.5**	**160.8**	**184.8**	**166.5**	**188.5**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK)
Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

Table 3.12 EU-27 total protein crop production by MS, 2000-2007 ('000 tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007
France	2,039.7	1,852.5	2,008.3	1,916.9	2,067.3	1,721.1	1,316.7	898.0
Germany	530.2	717.3	569.2	562.6	618.3	500.9	421.8	323.0
Spain	84.7	74.4	153.7	209.3	275.7	178.8	262.6	207.7
UK	742.3	931.0	906.8	907.7	848.1	876.4	752.7	466.7
Belgium-Luxembourg	7.1	8.4	6.7	10.4	7.6	5.7	4.3	4.6
Denmark	137.0	111.4	139.4	105.6	83.3	43.2	26.2	19.4
Greece	5.7	4.9	5.0	3.9	4.7	4.7	4.1	6.6
Italy	88.6	92.2	93.7	99.4	119.0	124.9	130.8	140.2
Ireland	1.7	1.9	2.0	4.7	4.5	5.0	4.0	3.8
Netherlands	10.0	11.4	9.9	12.8	14.1	12.6	7.3	8.5
Portugal	15.0	15.0	15.0	15.0	15.0	16.5	17.5	18.0
Austria	103.6	119.8	102.2	103.0	130.5	101.5	103.6	68.0
Finland	11.7	11.5	11.1	10.2	5.6	8.1	8.8	10.7
Sweden	67.4	76.3	84.4	79.1	88.0	65.4	50.8	38.1
Poland	71.7	47.1	27.2	41.0	50.2	77.5	52.2	84.1
Hungary	51.3	67.1	51.9	32.9	66.4	52.8	51.4	52.7
Cyprus	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.4
Czech Republic	79.7	86.7	60.4	57.9	80.2	87.3	74.8	59.3
Estonia	5.3	5.0	4.8	4.8	3.2	5.7	5.5	9.4
Latvia	3.0	2.6	3.3	3.9	2.7	2.5	0.8	1.8
Lithuania	51.4	31.5	38.7	24.4	24.8	26.0	20.6	32.1
Malta	0.8	0.7	0.7	0.7	0.8	0.8	0.7	0.8
Slovakia	18.5	23.3	26.6	20.4	32.8	29.9	28.1	18.2
Slovenia	0.0	0.1	0.7	0.6	1.2	4.6	10.0	4.1
Bulgaria	5.3	9.0	9.2	4.1	5.2	2.7	2.8	5.9
Romania	14.2	21.7	20.5	23.5	57.0	38.8	35.7	16.6
Total	**4,146.3**	**4,323.2**	**4,351.7**	**4,255.3**	**4,606.4**	**3,993.7**	**3,394.0**	**2,498.7**

Source: FAO; ZMP (Germany); Hungary and Poland, Central Statistical Offices; PGRO and DEFRA (UK)
Note: The only MS listed in this table are those with planted areas in at least one year between 2000 and 2007.

Field pea output was steady from 2000 to 2004, but then fell rapidly. Field bean output expanded until 2005, before falling back. Sweet lupin production was higher after 2001 than it had been in 1998-2000, and stabilised at the higher level. Since 2005, total protein crop output has been very weak. 2008 estimates indicate that the total will be below 2.5 million tonnes as it was in 2007. This is under half the average total in the latter half of the 1990s.

4. The agronomy of protein crops

There are many alternative rotations practised by farmers who grow protein crops. Cereals are a major element of such rotations, but oilseeds and sugar beet also feature in many rotations, and rapeseed has taken the place of protein crops in many instances. On agronomic grounds, protein crops are not recommended to be grown more than one year in six.

Analysis of the FADN database reveals that few producers plant the crops on even 10% of their land.

Most protein crops are planted in spring, though some winter plantings occur. Many farmers aim to plant most of their arable areas to cereal and oilseed crops in late autumn, but when weather problems delay the harvesting of autumn crops, these delays may oblige producers to make some springtime plantings. While this restricts the options available to them, protein crops may be planted at that time (making them an opportunistic choice in terms of production decisions) and still be expected to generate a fairly good return to the farmer.

Mention was made earlier to the eligibility of mixtures of protein crops and cereals for coupled protein crop payments, provided protein crops are the predominant component of such mixtures. During interviews with producer associations and ministries of agriculture, it was said that, in practice, such mixtures are of minor importance in terms of the production that is in receipt of coupled protein crop payments. No statistical data are available on such mixtures, since these mixtures are not classified separately by the payment agencies.

Instead, there are areas, notably in Poland, but also among organic farmers throughout the Community, where protein crops are grown as a minor proportion (typically 20-30%) of the seed in a mixture with cereals[27]. This production occurs principally where the resulting mixed crop is destined almost entirely for on-farm feed use, to enable the producer to minimise protein ingredient purchases for feed and saving on transport costs for inputs. In the case of organic producers of meat, on-farm production ensures the traceability of their protein feed ingredients. Because of the low proportion of protein crops in mixtures in both cases, this production would not be entitled to any coupled special aids, where they are applied.

5. EU protein crop demand for feed uses

This section analyses the demand for protein crops in protein feed demand. Diagram 3.13 describes the changing proportions of protein crops within the overall EU demand for vegetable protein feeds in compound feed since 1993, derived from the data in Table 3.13.

An important structural change in the feed sector during this period was the impact of BSE on the use of animal sources of protein in livestock feed. Most uses of such ingredients, notably meat and bone meal, were banned in 2001. Therefore, this input, which provided nearly 7% of

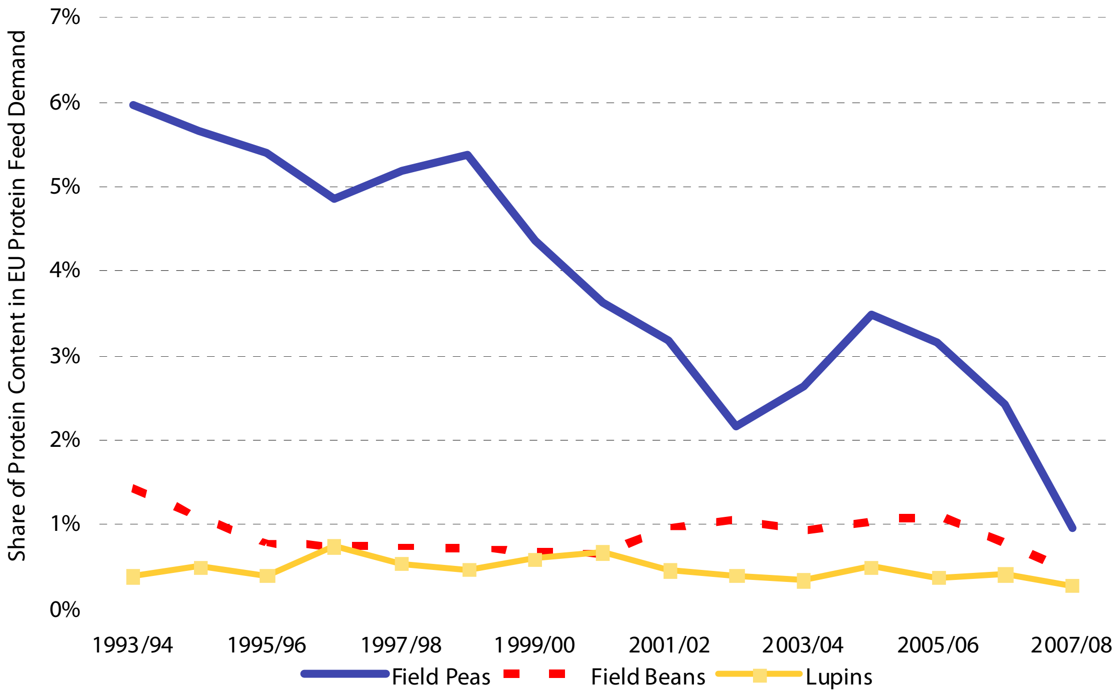
[27] The areas planted to cereal-protein crop mixtures are reported as protein crop areas in Polish national agricultural statistics, but they have not been included in the protein crop area in the current analysis, since they would not be defined as protein crop areas in EU regulations. In any event, since Poland has no separate CNDP scheme for protein crops, mixtures are not eligible for any special payment, over and above that paid on cereal areas, and so output of such mixtures is not affected directly by the CAP measures for protein crops.

protein feed in the 1990s, experienced a sharp drop in its rate of incorporation after 2000. This is evident from Table 3.11, which describes the changing composition of protein feed use in EU compound feed in 1993-1999, 2000-2003 and after the 2003 reform (2004-2007), including meat and bone meal as well as vegetable protein. All values are in protein content.

Meat and bone meal has a protein content of up to 60%, similar to fishmeal, and the highest level among major feed ingredients. Field peas, the main protein crop, has a protein content of only 21%,; that of field beans is 26% ; and that of sweet lupins averages around 35%. The field pea protein content is the lowest level among the major protein ingredients and it was widely used in blends with meat and bone meal to obtain a product with an average protein content high enough to be attractive for chicken and pig feed.

The exclusion of meat and bone meal from feed reduced the appeal of field peas for feed compounding, and the subsequent decline in protein crop use in compound feed is evident from the tables and diagram. Within an overall market that grew only very slowly, rapeseed meal made the greatest gains in relative terms, following its much greater supply as a by-product of rapeseed crushing for biodiesel manufacture.

Diagram 3.13: The share of protein crops in total EU vegetable protein feed demand in tonnes of protein content, 1993/94-2007/08



Source: LMC estimates, using FAO, DG Agri, COMEXT, FEFAC, AC Toepfer and US Department of Agriculture data

Table 3.13: The composition of EU demand for vegetable protein feed ingredients, 1993/94-2007/08 ('000 tonnes of protein content)

	Meal					Protein Crops						Sum
	Soybean	Rapeseed	Sunflower	Palm Kernel	Other Oilseeds	Field Peas	Field Beans	Lupins	Dry Fodder	DDGS	Corn Gluten Feed	
1993/94	11,226	1,718	1,337	343	752	1,166	282	88	899	331	1,533	19,674
1994/95	12,252	1,868	1,535	364	688	1,166	228	110	879	331	1,533	20,954
1995/96	11,455	1,951	1,612	375	639	1,076	157	85	805	305	1,554	20,014
1996/97	10,857	1,822	1,778	379	549	950	144	150	733	305	1,696	19,363
1997/98	11,906	2,015	1,664	386	500	1,029	148	114	799	305	1,221	20,087
1998/99	13,171	2,126	1,714	409	444	1,175	159	101	857	305	1,365	21,825
1999/00	12,889	2,325	1,629	423	462	928	146	126	857	305	1,348	21,438
2000/01	13,513	2,148	1,535	437	482	773	142	144	886	305	1,331	21,696
2001/02	14,699	2,053	1,265	450	468	704	217	104	851	305	1,314	22,429
2002/03	14,667	2,077	1,324	458	431	482	235	88	852	348	1,314	22,276
2003/04	14,401	2,075	1,482	485	332	579	205	76	861	325	1,192	22,014
2004/05	14,379	2,548	1,351	560	276	790	235	114	911	297	1,136	22,597
2005/06	14,465	2,889	1,381	530	242	717	251	86	831	310	978	22,680
2006/07	14,604	3,094	1,393	439	264	555	178	95	783	272	956	22,631
2007/08	15,353	3,539	1,202	459	264	223	101	55	806	341	582	22,925

Sources: DG Agri., FEFAC, AC Toepfer, USDA

Note: The data refer to the demand in feed compounding

Table 3.14: EU-27 demand for vegetable protein feed ingredients plus meat and bone meal in compound feed ('000 tonnes, protein content)

	Average	Average	Average
	1993-1999	2000-2003	2004-2007
Soybean meal	11,965	14,320	14,735
Rapeseed meal	1,975	2,088	3,018
Field peas	1,076	639	569
Field beans	181	200	191
Sweet lupins	107	104	90
Dry fodder	833	862	833
Other vegetable protein	4,345	3,896	3,300
Total vegetable protein	***20,481***	***22,109***	***22,735***
Meat and bone meal	1,489	476	298
Combined total	**21,971**	**22,586**	**23,033**

Sources: DG Agri. FEFAC, AC Toepfer, USDA

6. The EU supply-demand balances for protein crops

In this section, we summarise EU-27 supply-demand balances for protein crops in 1993-2008 and also the composition of end-use demand, including food uses (without further processing), processing applications (for processed foods, such as canned mushy peas, and as an ingredient in the production of products such as baked goods), as well as "feed and other" demand, which combines feed consumption in industrial feed compounding units and the tonnages used in on-farm feeding, and also includes tonnages of planting seeds and waste.

FAO SUA data for demand by sector and MS are available until 2003. Since 2004, FAO end-use data are not available. In the absence of this information, it has been assumed that both food uses and processing demand were steady in absolute terms, because their demand was much more stable than feed demand between 1993-1999 and 2000-2003. These uses are assumed to remain at their 2003 levels for most MS; however, in a small number of MS, where this assumption would imply negative feed demand in some years after 2003, it was assumed that food and processing demand maintained their proportional shares of the total demand for the relevant protein crop. Because processing demand for all protein crops fell by only 14,000 tonnes per annum between 1993-1999 and 2000-2003, while food demand for protein crops as a whole increased by only 6,000 tonnes, any errors introduced by these assumptions are expected to be modest in relation to the sharp declines estimated in feed uses.

Table 3.15 indicates that processing demand is confined to field peas (mainly for marrowfat peas which are canned for food use), and recently represented roughly 2% of total protein crop demand; food demand accounted for 17% of the total, leaving more than 80% for feed and other uses (including seed and waste) in 2004-2008. Every segment of demand, apart from food uses of field beans, fell after the reform. The consumption of these crops in feed and other uses declined by a larger percentage than it did in either food or processing.

Foreign trade displayed contrasting trends after 2003. Imports of all protein crops fell, which left the combined volume of imports down by 13%. Exports of field peas and sweet lupins fell, while those of field beans expanded, but combined exports fell by 23%. Net imports of field peas (shown as negative net exports) rose 143% after 2003, but fell 46% for sweet lupins. The trade balance in field beans was transformed from one of net imports into one of net exports in 2004-2006. Combined net imports of protein crops rose 18%.

The output of field peas fell 33% after 2003, but rose by 13% for field beans and 2% for sweet lupins. The major role of field peas meant that the combined tonnage fell by 21%.

Table 3.15: EU-27 supply-demand balances for protein crops, 1993-2008 ('000 tonnes)

Field Peas	Demand				Foreign Trade			
	Feed & Other	Food	Processing	Total Demand	Exports	Imports	Net Exports	Production
1993-1999	4,651	535	99	5,285	1,517	2,054	-537	4,748
2000-2003	2,759	502	85	3,347	962	1,196	-233	3,114
2004-2008	2,120	457	81	2,659	620	1,187	-567	2,092
% Change 2000-2003 to 2004-2008	*-23.2%*	*-8.9%*	*-4.4%*	*-20.6%*	*-35.5%*	*-0.7%*	*142.9%*	*-32.8%*
Field Beans	Demand				Foreign Trade			
	Feed & Other	Food	Processing	Total Demand	Exports	Imports	Net Exports	Production
1993-1999	753	152	0	905	149	321	-172	733
2000-2003	832	191	0	1,023	238	244	-6	1,017
2004-2008	775	192	0	968	325	145	180	1,148
% Change 2000-2003 to 2004-2008	*-6.8%*	*0.6%*	*N/A*	*-5.4%*	*36.5%*	*-40.5%*	*N/A*	*12.8%*
Sweet Lupins	Demand				Foreign Trade			
	Feed & Other	Food	Processing	Total Demand	Exports	Imports	Net Exports	Production
1993-1999	346	1	0	347	12	230	-219	128
2000-2003	323	1	0	324	47	212	-164	159
2004-2008	251	1	0	252	14	103	-89	162
% Change 2000-2003 to 2004-2008	*-22.3%*	*0.0%*	*N/A*	*-22.2%*	*-70.4%*	*-51.3%*	*-45.8%*	*2.1%*
All Protein Crops	Demand				Foreign Trade			
	Feed & Other	Food	Processing	Total Demand	Exports	Imports	Net Exports	Production
1993-1999	5,750	688	99	6,536	1,678	2,605	-927	5,609
2000-2003	3,914	694	85	4,694	1,248	1,651	-404	4,290
2004-2008	3,146	651	81	3,878	959	1,435	-476	3,402
% Change 2000-2003 to 2004-2008	*-19.6%*	*-6.3%*	*-4.4%*	*-17.4%*	*-23.1%*	*-13.1%*	*17.9%*	*-20.7%*

Sources: Estimated from FAO, FEFAC, AC Toepfer, USDA, Prolea, COMEXT and DG Agri data.

Note that data on the allocation of sectoral demand after 2004 are estimates, since the FAO SUA data do not exist for these more recent years. Feed demand includes seeds for planting, stock changes and waste.

7. The development of protein crop prices

The availability of regular EU quotations for protein crops is limited. In the EU, the prices most widely quoted as the basis for transactions are French market prices published in the weekly journal, *La Dépêche*. Unfortunately, apart from feed peas, the price series cover only a part of the marketing year. UNIP also reports protein crop prices for selected French regions. In view of France's major share of EU protein crop output and its sales to other MS, protein crop prices in other MS are built up from French prices, adding freight costs from France.

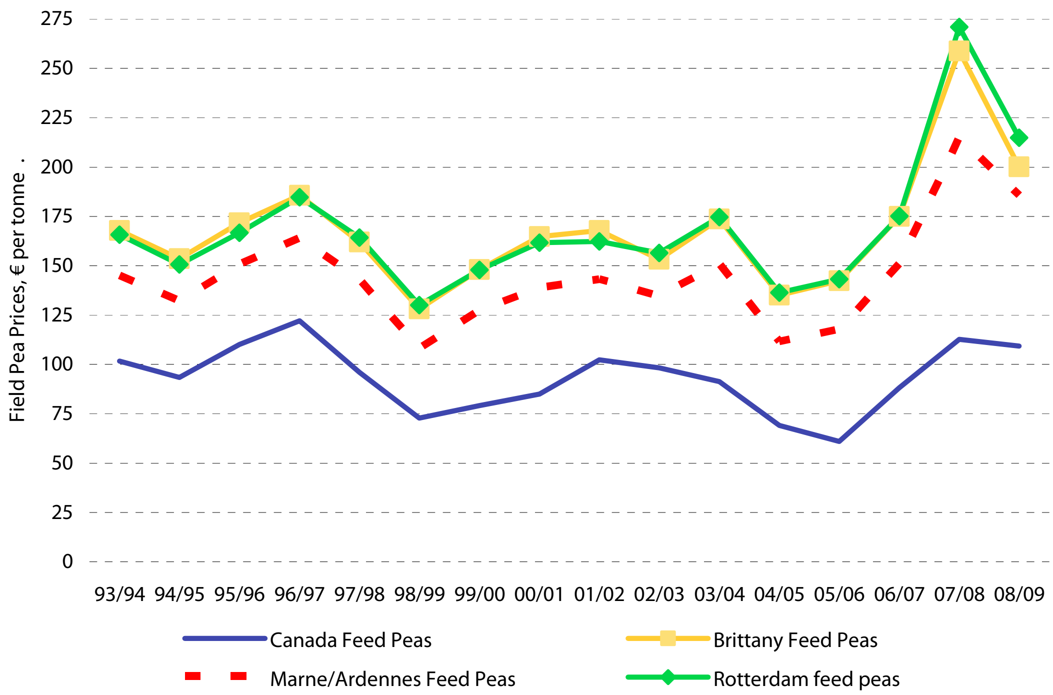
The other main regular source of EU price data on protein crops is LEI in the Netherlands. The country is a major location for feed compounding and Rotterdam port handles large volumes of feed ingredients, many of them in transit to other EU member states; therefore Rotterdam prices are widely used as a reference for trade within the Community. The LEI prices tend to reflect Rotterdam wholesale prices for compounders, rather than producer prices.

There is no recognised quoted world price. Price series for the largest field pea exporter, Canada, give the best indication of international prices. Leading traders in field peas state that Canadian prices form the basis for their export sales of different grades of the product.

7.1. Price by type of crop

A comparison of EU and Canadian field pea prices by marketing year is depicted in Diagram 3.14. In 1993/94-2004/05, prices in Brittany and Rotterdam tracked each other closely, trading within a range of €125-175 per tonne. Prices in Marne/Ardennes have followed the same dynamics, although they have traded within a lower price range. The difference between the two French quotations is in line with transport costs from one region to another.

Diagram 3.14: Comparison of Canadian and EU field pea prices, 1993/94-2007/08



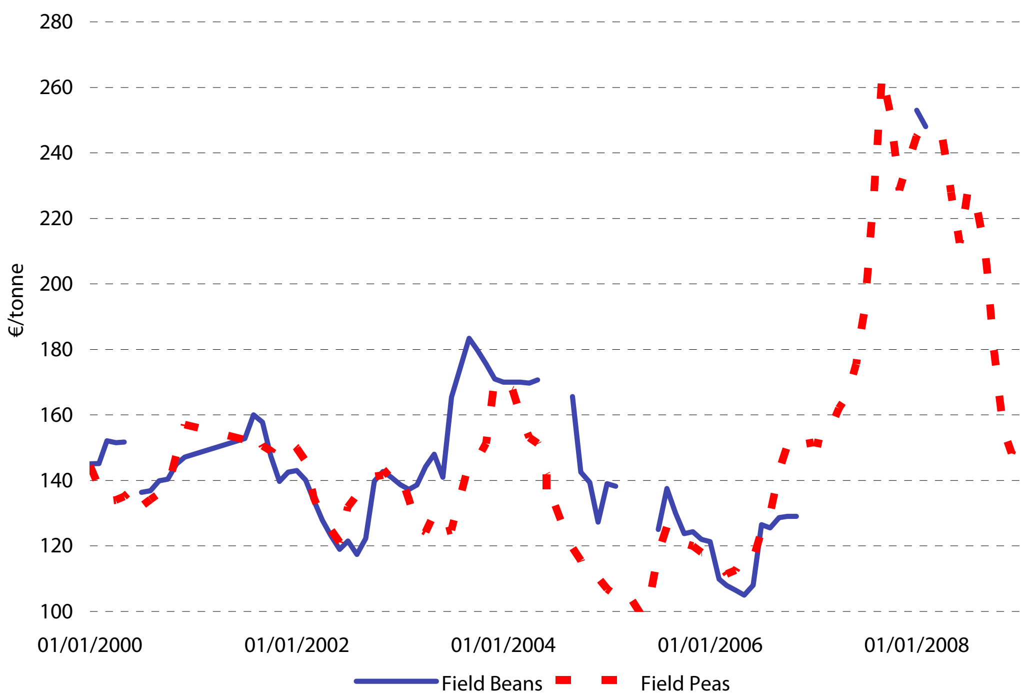
Source: Stat Canada; *La Dépêche*, UNIP, LEI

Canadian prices appear to be linked with the French quotations. The difference between the Canadian and French prices is consistent with the costs of freight from Saskatchewan to the coast, and then to France or the Netherlands. The latter difference widened, as would be expected in the light of higher fuel prices and shipping freight rates in 2006/07 and 2007/08, it has narrowed more recently, as these transport costs have declined.

Diagram 3.15 compares weekly field peas and bean prices for Marne/Ardennes, France. Field bean market prices are only available in many years in the weeks after the harvest; thereafter, traded volumes are considered too small to be representative. On average, in weeks when field bean quotations exist, they tend to be above field pea prices. The average differential for field beans over field peas, where both are used in feed, is almost exactly €5 per tonne.

No detailed analysis can be undertaken for sweet lupins as price quotations for this crop are less readily available than those for the other two protein crops. This is partly because lupins are more widely consumed on-farm, as a captive source of protein feed, and hence the volumes entering the market are small. For the months for which quotations have been available for both lupins and field peas, the lupin premium over field peas in the Centre region of France averaged 23%, which reflects the higher protein content of lupins.

Diagram 3.15: Producer prices of field peas and field beans, Marne/Ardennes, France



Source: *La Dépêche*,

7.2. Protein crop prices by end use

With regard to prices of protein crops in different uses, a comparison of feed pea and food pea prices in the French region of Eure et Loir revealed that the average premium for yellow peas over field peas for feed uses over the evaluation period was approximately €15 per tonne. This is consistent with the figure of €15 to €30 mentioned in a major French reference source[28].

The premium paid for food grade field beans (faba beans) for export to North Africa over field beans for feed uses depends to a large extent upon North African import demand. *La filière protéagineuse* (cited above) states that the typical premium is €15-€30 per tonne, which is similar to the premium for food peas over feed peas. However, this rose substantially in 2007/08, before declining to more normal levels in 2008/09.

[28] *La filière protéagineuse, Quels défis?*, Jacques Guéguen and Gérard Duc (eds.), Editions Quae, 2008

Canada is a valuable source to use to verify the conclusion regarding field pea prices, since it regularly supplies the EU market without import tariff barriers[29]. It is reassuring to observe that French field pea prices for feed uses move broadly in parallel with those in Canada, as demonstrated in Diagram 3.14. It is also reassuring to note that the average differential of €15-€30 per tonne between EU food and feed prices for field peas is in line with the evidence from Canadian field pea price differentials between sales for food and feed uses.

[29] MFN import tariffs on field peas are 0%, on field beans 3.2% and on sweet lupins 2.5%.

Chapter 4: Answer to Theme 1 Question: Impacts on the Production of Protein Crops

Evaluation Question 1: Impacts on the production of protein crops

To what extent have the CAP measures applicable to the protein crop sector affected the output of protein crops, with regard to the choice of crop, area; yield; prices paid to producers; geographical distribution?

To what extent has the special aid for protein crops been an incentive to increase the production of these crops? (Special attention will be paid to impacts linked to crop rotation.)

In this chapter, we assess the extent to which the CAP measures for protein crops affected protein crop production in member states (MS). The focus of analysis is the period since the 2003 reform; however, to appreciate the nature of the changes over the past five years, they are placed in the context of developments in earlier years, when different measures applied.

There are several facets to producers' response to the measures affecting the protein crop sector introduced in the 2003 reform. One is the area planted to protein crops. A second is the geographical distribution of those areas by MS. Third is the choice of protein crop. Fourth is producers' decisions regarding production intensity and yields from the crop, although yields also depend on external factors beyond the farmers' control. A final influence is the level of the prices paid for protein crops.

A specific issue in the discussion is the extent to which the special aid encouraged higher protein crop production. Since a special feature of these crops is the externalities they provide to succeeding crops in crop rotation, attention is paid to the quantification of these benefits.

The discussion of this Evaluation Question (abbreviated as EQ1) follows the order of the judgement criteria listed in Table EQ1.1.

1. Judgement criteria, indicators, data sources and evaluation tools:

The judgement criteria, indicators and data sources relevant to this question are summarised in the following table.

Table EQ1.1: Judgement criteria, indicators and data sources regarding production

Judgement Criteria	Indicators	Data Sources
Changes in areas of protein crops over time, by protein crop type and MS vs. area changes of other arable crops, notably common wheat, barley, maize, rye, rapeseed and sunflower	Areas of field peas, field beans and sweet lupins - by type and end-use (i.e., feed vs. food)	DG Agri, COPA-COGECA, Prolea
	Areas of other COP crops: notably common wheat, barley, maize, rye, rapeseed and sunflower	Eurostat, COPA-COGECA, FAO, National & regional sources
Changes in the geographical distribution of protein crop areas by MS by type of protein crop	Distribution of field peas, field beans and sweet lupin area by MS and NUTS1 region	DG Agri, Eurostat, FAO, National & regional sources
Impact of measures promoting non-food/non-feed uses of COP crops upon the areas planted to protein crops	Shares of area under protein crops after the reform, with and without areas for non-food set-aside and energy crops	DG-Agri National & regional sources
Impact of the ending of the coupled aids for grain legumes	Trends in area protein crops and grain legumes in Spain	National & regional sources

Changes in yields of protein crops over time, by crop type and MS vs. yield changes of other COP crops	Yields of field peas, field beans and sweet lupins	DG Agri
	Yields of other COP crops Input use per hectare Direct production costs per hectare Proportional changes in protein crop areas since 2003 vs. reference yields under regionalisation plans	Eurostat National & regional sources Farmer questionnaires DG Agri Eurostat FAO
Changes in the output of protein crops	Output of protein crops by MS - by type and end-use (feed and food)	DG Agri FAO National & regional sources
Changes in the structure of protein crop production	Distribution of protein crop production by size of holdings by MS and the proportions of their areas under protein crops	FADN
	Distribution of protein crop output by type of specialisation by MS and the proportions of their areas under protein crops	FADN
Changes in protein crop prices	Differentials between the prices of individual protein crops by variety/colour/end-use	National & regional sources *La filière protéagineuse, quels defis?* Ed. Guéguen & Duc, 2008

2. Effects of the 2003 reform on the protein crop area

In Chapter 3, we reviewed the evolution of total EU-27 areas under protein crops since 2000. In the Appendix we provide annual data by MS. Here, we analyse changes in these areas in relation to changes in the areas of the other main cereal, oilseed and protein (COP) crops since the 2003 reform.

This analysis is based on area data from DG Agri, Eurostat and FAO, supplemented by data from national statistical offices in Hungary and Poland and from agriculture ministries in Germany, Malta and the UK. Estimates for the 2008/09 protein crop area are derived from data published by COPA-COGECA and Prolea.

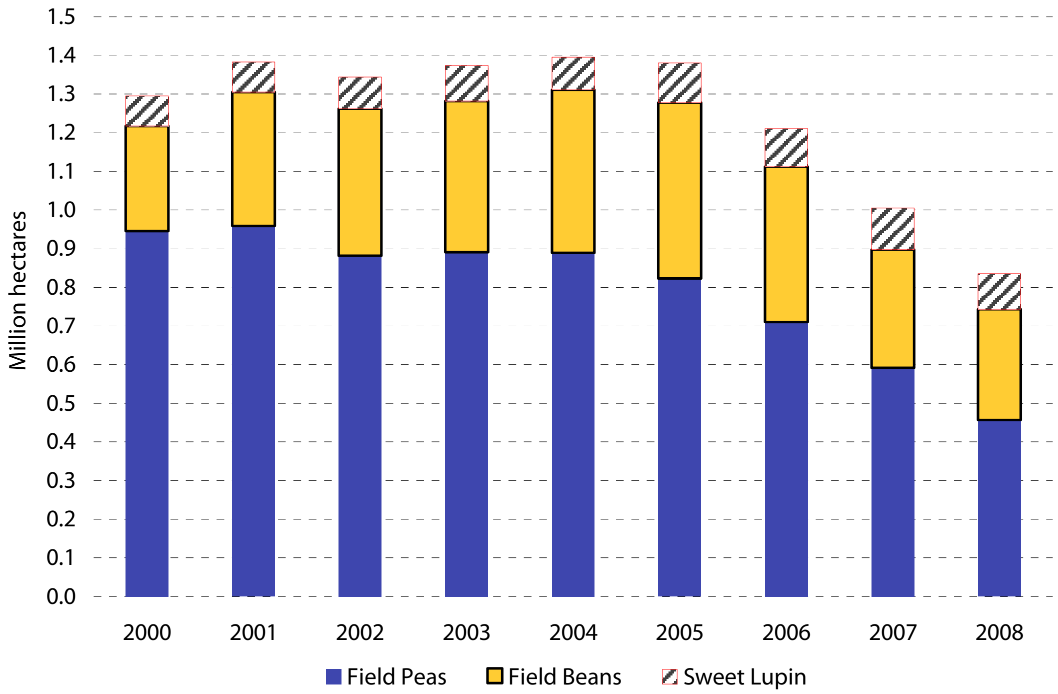
The indicators that are relevant to this discussion are: the areas of field peas, field beans and sweet lupins by MS, and areas of other major COP crops, namely common wheat, barley, durum wheat, maize, “other cereals” (mainly rye, oats and triticale), rapeseed and sunflower, also by MS.

2.1. Summary of changes in protein crop areas

Within the EU-27, the total area under protein crops moved within a relatively narrow band between 1.3 and 1.4 million hectares between 2000/01 and 2005/06, prior to the full implementation of the measures, including the SPS decoupled single farm payment scheme in all EU-15 MS, which were introduced in the 2003 reform.

As has already been described in Chapter 3, the total protein crop area subsequently declined, falling towards 0.8 million hectares in 2008/09 (Diagram EQ1.1).

Diagram EQ1.1: EU-27 protein crop area



Source: DG Agri; FAO; data in Tables 3.1-3.3; COPA-COGECA and Prolea (the latter two are the basis for 2008-09 estimates)

While field peas dominate the total protein crop area, their share of the total area has fallen from 73% of the total area at the beginning evaluation period to its most recent level of 55% of the protein crop area in 2008. The field bean share of the total area rose from 21% to 34% between these years, while the sweet lupin share expanded from 6% to 11%.

In the EU-15 the largest protein crop areas are found in France, Spain, Germany and the UK. Together they accounted for 72% of the total 2004-2008 protein crop area of EU-27. Table EQ1.2 summarises the change in protein crop areas by MS between the 2000-2003 crop years and 2004-2008.

The new member states (EU-12) represented 18.7% of the total protein crop area within the EU-27 after 2003. Within the EU-12, Poland is the MS with the largest protein crop area. This is largely because it is the second largest producer of sweet lupins in the EU-27 after Germany. Polish farmers planted over 30% of the total EU-27 sweet lupin area in 2004-2008.

Together, the six case study MS (France, Spain, Germany, UK, Poland and Hungary) accounted for 78% of the total protein crop area within the EU-27 in the period after 2003.

Under the 2003 CAP reform, the payment of the special aid for protein crops (€55.57 per hectare) is subject to a limit determined by the Maximum Guaranteed Area (MGA). If the MGA is exceeded, the payment is reduced *pro rata*.

Table EQ1.3 contrasts the development of the areas under protein crops with the MGA over the evaluation period. It also lists the shortfall of the actual area from the MGA in each year.

The table reveals that, since 2000, the area planted to protein crops within the EU (reflecting the actual membership each year) has always been smaller than the MGA. In addition, while the MGA expanded in 2004 and 2006, following the enlargements, the total EU protein crop area experienced a sharp decline. In 2008, the total area was just over half the MGA.

Table EQ1.2: EU-27, Protein crop areas by MS, 2000-2003 vs. 2004-2008 ('000 hectares)

	Field peas			Field beans			Sweet lupins			All protein crops		
	2000-2003	2004-2008	% Change	2000-2003	2004-2008	% Change	2000-2003	2004-2008	% Change	2000-2003	2004-2008	% Change
Belgium-Lux	2.0	1.4	-28.4%	0.0	0.1		0.0	0.0		2.0	1.5	-24.4%
Denmark	33.0	10.9	-67.0%	0.0	0.0		0.0	0.0		33.0	10.9	-67.0%
Germany	147.4	88.0	-40.3%	19.4	13.8	-28.8%	34.0	33.3	-2.2%	200.8	135.1	-32.7%
Greece	0.3	0.4	40.1%	2.4	2.3	-1.3%	0.4	0.2	-33.2%	3.0	3.0	-1.4%
Spain	69.0	142.6	106.5%	26.5	36.8	38.6%	14.8	9.6	-35.2%	110.3	188.9	71.2%
France	387.6	239.8	-38.1%	54.6	74.9	37.0%	12.1	6.3	-47.5%	454.3	321.0	-29.3%
Ireland	0.6	1.0	53.6%	0.0	0.0		0.0	0.0		0.6	1.0	53.6%
Italy	7.1	12.0	70.0%	45.1	47.8	6.0%	3.5	2.7	-21.6%	55.6	62.5	12.4%
Netherlands	1.8	1.9	5.0%	0.6	0.6	-4.9%	0.0	0.0		2.5	2.5	2.4%
Austria	40.8	31.7	-22.4%	3.2	3.8	21.2%	0.0	0.3	570.5%	44.0	35.8	-18.6%
Portugal	0.0	0.0		24.0	23.7	-1.2%	0.0	0.0		24.0	23.7	-1.2%
Finland	5.0	3.7	-26.1%	0.0	0.0		0.0	0.0		5.0	3.7	-26.1%
Sweden	29.7	20.4	-31.0%	0.0	0.0		0.0	0.0		29.7	20.4	-31.0%
UK	82.5	41.8	-49.3%	154.0	156.4	1.6%	4.3	6.0	41.2%	240.8	204.2	-15.2%
EU-15	**806.8**	**595.6**	**-26.2%**	**329.8**	**360.1**	**9.2%**	**69.0**	**58.5**	**-15.2%**	**1,205.5**	**1,014.2**	**-15.9%**
Cyprus	0.0	0.0		0.4	0.5	35.0%	0.0	0.0		0.4	0.5	35.0%
Czech Rep.	29.5	23.6	-20.0%	3.2	2.8	-13.8%	0.0	0.0		32.7	26.4	-19.4%
Estonia	3.1	4.7	49.4%	0.0	0.0		0.0	0.0		3.1	4.7	49.4%
Hungary	24.2	20.3	-16.3%	3.0	0.9	-69.3%	0.7	0.2	-70.3%	27.9	21.4	-23.3%
Latvia	1.9	1.2	-38.1%	0.0	0.0		0.0	0.0	65.6%	1.9	1.2	-36.8%
Lithuania	17.8	14.2	-20.6%	0.0	0.0		1.8	7.6	332.0%	19.6	21.7	11.0%
Malta	0.0	0.0		0.3	0.3	5.5%	0.0	0.0		0.3	0.3	5.5%
Poland	6.7	5.9	-12.4%	9.8	8.2	-17.0%	11.1	30.0	169.2%	27.7	44.0	59.0%
Slovakia	11.1	9.5	-13.7%	0.7	1.2	88.8%	0.0	0.4		11.7	11.2	-4.4%
Slovenia	0.2	1.7	980.3%	0.0	0.1		0.0	0.0		0.2	1.8	1050.9%
Bulgaria	3.5	1.1	-69.4%	0.3	0.1		0.0	0.5		3.8	1.7	-55.9%
Romania	14.4	17.7	22.2%	0.0	0.0		0.0	0.0		14.4	17.7	22.2%
EU-12	**112.4**	**99.7**	**-11.3%**	**17.6**	**14.1**	**-20.1%**	**13.6**	**38.7**	**184.4%**	**143.6**	**152.5**	**6.1%**
EU-27	**919.2**	**695.3**	**-24.4%**	**347.4**	**374.2**	**7.7%**	**82.6**	**97.1**	**17.7%**	**1,349.2**	**1,166.7**	**-13.5%**

Source: DG Agri; FAO; data in Tables 3.1-3.3; COPA-COGECA and Prolea (the latter two are the basis for 2008-09 estimates

Table EQ1.3: Comparison of actual protein crop area and MGA ('000 hectares)

	EU	MGA	% shortfall
2000	1,118	1,400	-20%
2001	1,236	1,400	-12%
2002	1,219	1,400	-13%
2003	1,354	1,400	-3%
2004	1,370	1,600	-14%
2005	1,367	1,600	-15%
2006	1,211	1,648	-27%
2007	1,008	1,648	-39%
2008	838	1,648	-49%

Source: DG Agri; FAO; data in Tables 3.1-3.3; COPA-COGECA and Prolea (the latter two are the basis for 2008-09 estimates)

2.2. Changes in areas of protein crops and other COP crops after 2003

Table EQ1.4 describes the distribution of EU-27 areas among the major cereal, oilseed and protein (COP) crops from 2000 to 2008.

Total protein crop areas are listed on the first row and are disaggregated between each of the individual protein crops, whose areas are listed in italics. The last two columns compare the averages in 2000-2003 and 2004-2008.

Table EQ1.4: EU-27, Protein crops and competing COP crop areas (million hectares)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average 2000-2003	Average 2004-2008
Protein crop	1.30	1.38	1.34	1.37	1.40	1.38	1.21	1.01	.84	1.35	1.17
Field peas	*.95*	*.96*	*.88*	*.89*	*.89*	*.82*	*.71*	*.59*	*.46*	*.92*	*.70*
Field beans	*.27*	*.35*	*.38*	*.39*	*.42*	*.45*	*.40*	*.31*	*.29*	*.35*	*.37*
Sweet lupin	*.08*	*.08*	*.08*	*.09*	*.08*	*.10*	*.10*	*.11*	*.09*	*.08*	*.10*
Rapeseed	4.18	4.18	4.27	4.17	4.56	4.82	5.34	6.54	6.17	4.20	5.48
Sunflower	3.75	3.48	3.52	4.28	3.82	3.62	3.94	3.40	3.64	3.76	3.69
Common wheat	22.95	22.71	23.05	20.86	22.66	22.81	21.92	21.95	23.38	22.39	22.54
Barley	14.26	14.41	14.34	14.02	13.72	13.82	13.81	13.78	14.62	14.26	13.95
Maize	9.53	9.57	9.34	9.80	10.10	8.96	8.53	7.86	8.87	9.56	8.86
Durum wheat	3.68	3.78	3.95	3.84	3.79	3.54	3.01	2.83	3.16	3.81	3.26
Other cereal	10.69	10.59	10.23	10.02	10.08	9.88	9.66	10.13	10.06	10.38	9.96
Total Area	**70.34**	**70.10**	**70.05**	**68.35**	**70.13**	**68.83**	**67.42**	**67.49**	**70.73**	**69.71**	**68.92**

Source: DG Agri; FAO; data in Tables 3.1-3.3; COPA-COGECA and Prolea (the latter two are the basis for 2008-09 estimates)

3. Effects of the 2003 reform on the geographical distribution of protein crop areas

Table EQ1.2 presented the data on the changes in protein crop areas by MS after the 2003 reform[30]. From this, we observe that the changes in areas varied considerably between MS. Focusing on the 12 largest producing MS, with 95% of the total protein crop area after 2004, we see that:

- The largest declines in areas occurred in Germany (down 32.7% between 2000-2003 and 2004-2008), Sweden (down 31.0%) and France (a drop of 29.3%).
- Among other EU-15 MS, Spain (with protein crop area growth of 71.2%) had a very different experience from other major protein crop-producing MS. Particularly striking was the rise in the field pea area, which more than doubled after the reform. Spain had large areas of grain legumes, receiving coupled payments until the 2003 reform. To examine whether this explained the expansion of Spanish protein crop areas after 2003, when grain legume areas fell sharply, we present a special analysis later in this chapter.
- Other major EU-15 protein crop producers had mixed fortunes. The UK experienced a total area decline of 15.2%, despite expansion of 1.6% in the field bean area.
- Italy's total protein crop area was up 12.4%, with increases in both field peas and field beans, though a decline occurred in its sweet lupin areas.
- Portugal's area, all planted to field beans, was down a modest 1.2%.
- Meanwhile Austria, heavily weighted towards field peas, saw its total area drop 18.6%.
- The main EU-12 producers also had mixed outcomes. Poland's protein crop area grew by 59.0%, under the lead of sweet lupins.
- The protein crop area in Lithuania, the only EU-12 MS with coupled CNDP payments specifically for protein crops, expanded 11.0%, again under the lead of sweet lupins.

[30] It should be noted that the percentage changes in the table refer to changes in the actual areas. As such, they differ from the changes in the shares of the total COP areas under protein crops, analysed in Table EQ1.5.

- In contrast, Hungary's area was down 23.3% and that in the Czech Republic was down 19.4%. In both of these, field peas represented around 90% of their protein crop area.

Table EQ1.5 interprets the changes for each EU-27 MS between 2000-2003 and 2004-2008 in their areas under the main COP crops in a slightly different manner, in terms of the proportional changes in the share of COP crop areas, since this provides a good indication of the relative change in areas under alternative COP crops after the 2003 reform.

In this calculation, a decline in the area under an individual crop from, say, 2.5% to 1.5% of the overall COP crop area would be calculated as a proportional decrease of 40%, i.e., 1.0/2.5, in a protein crop area. This is considered to be a good indication because it reveals the extent to which producers, subject to constraints such as set-aside obligations in EU-15 MS, made a conscious choice to expand or reduce their overall COP crop areas, including protein crop areas, after the reform, and then decided how much of the total area to allocate to each crop.

The table reveals that, in allocating their land to individual COP crops after the 2003 reform, EU-27 producers as a group reduced the share of their COP areas under protein crops by 12.5%, combining a 6.3% relative increase in the EU-12 and a 14.2% fall in the EU-15.

- The main cut-back was in field peas, with a proportional reduction of 23.4%. This was made up of a 24.7% relative decline for the EU-15 and 11.2% for the EU-12.
- The trend was positive overall for field beans. The EU-15 area rose by 11.3% in relative terms after the reform, but fell 20.1% in the EU-12. The predominance of EU-15 plantings, however, ensured that the overall EU-27 area expanded 8.9% as a proportion.
- The area under sweet lupins was boosted by the EU-12 MS, increasing by 19.1% in relative terms, as the 185.6% expansion in the EU-12 offset a 13.5% fall in the EU-15.
- Among other COP crops, the one that has gained most was rapeseed. The area under this crop increased 32.2% in proportional terms in the EU-27. This is particularly significant for protein crops, since rapeseed is an alternative to protein crops as a break crop in cereal farming. Rapeseed benefited from CAP energy crop measures promoting crop output for industrial uses, notably biofuels. Rapeseed plantings were also stimulated by measures permitting cultivation for non-food uses on set-aside land[31].
- The other COP crop whose share of EU-27 COP areas expanded was common wheat. The relative gain in its share was 1.9%.
- Durum wheat experienced a relative decline of 13.4% in its share of EU-27 COP area, a slightly faster rate of decrease than protein crops as a group, though significantly less steep than the decline recorded for field peas alone.
- Maize, too, experienced a proportional decline (of 6.3%), as did other cereals (mainly rye, oats and triticale), which together were down 2.9%, barley (down 1.0%) and sunflower (a 0.9% relative decrease in the EU-27).

[31] Regarding the importance of the cultivation of rapeseed on set-aside land as a factor in the growth in the rapeseed share of overall COP crop areas, it is significant that the application of 0% compulsory set-aside in 2008/09 saw the rapeseed share of the total EU-15 COP crop area fall from 10.4% the previous year to 8.9%.

Table EQ1.5: Proportional changes between 2000-2003 and 2004-2008 in individual crop shares of EU-27 MS COP areas

	Protein crop	*Field pea*	*Field bean*	*Sweet lupin*	Rapeseed	Sunflower	Common wheat	Barley	Maize	Durum wheat	Other cereals
Belgium-Lux	-28.6%	*-32.1%*			44.4%		0.4%	-11.8%	17.3%		-21.6%
Denmark	-66.5%	*-66.5%*			50.8%		7.5%	-8.6%			-5.7%
Germany	-32.3%	*-39.9%*	*-28.4%*	*-1.6%*	16.5%	-4.6%	5.9%	-3.9%	8.4%	35.9%	-17.0%
Greece	13.4%	*60.0%*	*12.9%*	*-19.2%*		-25.3%	14.9%	22.0%	10.9%	-11.2%	22.7%
Spain	77.2%	*113.8%*	*43.3%*	*-33.0%*	-46.0%	-17.8%	0.8%	7.4%	-12.3%	-20.3%	10.2%
France	-30.3%	*-38.9%*	*34.5%*	*-48.1%*	21.0%	-10.8%	2.2%	-1.0%	-11.6%	28.4%	1.2%
Ireland	54.1%	*54.1%*			79.3%	0.0%	4.0%	-5.1%			18.0%
Italy	18.0%	*78.7%*	*11.2%*	*-17.6%*	-69.5%	-27.4%	3.0%	3.6%	6.9%	-5.0%	16.1%
Netherlands	1.0%	*3.6%*	*-6.4%*		388.4%		7.6%	-15.6%	4.2%		-26.1%
Austria	-16.5%	*-20.4%*	*24.5%*	*583.7%*	-13.7%	35.2%	2.9%	-6.9%	3.7%	18.5%	3.0%
Portugal	41.5%	*0.0%*	*41.5%*	*63.6%*	-100.0%	-59.3%	151.4%	292.6%	5.8%	-76.3%	10.1%
Finland	-26.5%	*-26.5%*		*0.0%*	25.9%		27.9%	4.9%			-18.6%
Sweden	-24.5%	*-24.5%*			74.4%		4.7%	-0.4%			-12.9%
UK	-13.9%	*-48.6%*	*3.1%*	*42.8%*	30.5%	-8.2%	3.1%	-15.3%		-36.0%	7.6%
EU-15	**-14.2%**	***-24.7%***	***11.3%***	***-13.5%***	**23.5%**	**-16.1%**	**5.3%**	**-0.4%**	**-3.6%**	**-12.6%**	**-7.0%**
Cyprus	36.8%		*36.8%*					-0.7%		9.1%	-77.5%
Czech Republic	-18.8%	*-19.3%*	*-13.6%*		-1.1%	5.0%	-3.0%	-1.6%	46.8%		5.9%
Estonia	33.7%	*33.7%*			61.8%		25.0%	-10.3%			-33.9%
Hungary	-26.6%	*-19.8%*	*-70.9%*	*-71.9%*	51.8%	28.7%	-2.8%	-12.7%	-6.7%	-31.3%	0.7%
Latvia	-49.1%	*-50.5%*		*53.0%*	304.0%		0.8%	-17.6%			-16.6%
Lithuania	-1.4%	*-28.8%*		*273.8%*	109.5%		-5.8%	-8.6%	175.0%		-7.2%
Malta	*5.5%*		*5.5%*								
Poland	58.4%	*-12.4%*	*-16.9%*	*168.3%*	47.7%	368.9%	-11.7%	4.6%	22.4%		-1.0%
Slovakia	-4.0%	*-13.4%*	*90.9%*		36.1%	5.1%	-6.5%	-3.8%	3.6%	4.5%	-14.0%
Slovenia	1047.7%	*979.6%*			71.5%	-15.9%	-11.8%	37.2%	-9.3%		29.6%
Bulgaria	-53.2%	*-67.6%*	*-58.5%*		200.9%	31.7%	-2.7%	-11.5%	-21.5%	-38.7%	-35.9%
Romania	29.0%	*29.0%*			259.2%	1.7%	7.2%	-7.7%	-10.1%	18.0%	3.4%
EU-12	**6.3%**	***-11.2%***	***-20.1%***	***185.6%***	**56.9%**	**11.8%**	**-3.3%**	**-2.0%**	**-9.2%**	**-22.7%**	**-0.6%**
EU-27	**-12.5%**	***-23.4%***	***8.9%***	***19.1%***	**32.2%**	**-0.9%**	**1.9%**	**-1.0%**	**-6.3%**	**-13.4%**	**-2.9%**

Source: DG Agri; FAO; data in Tables 3.1-3.3; COPA-COGECA and Prolea (the latter two are the basis for 2008-09 estimates)
Note: "Proportional change in crop areas" measures relative changes in the % of the COP area in the relevant period. For example, a fall from 2.5% to 1.3% would yield a value of -48% (1.3 being 52% of 2.5). For Malta, the National Statistics office reports no cereal or oilseed areas. However, it does publish data on "forage" areas. The protein crop area is measured as a percentage of this forage area.

Changes in regional shares of areas planted to protein crops for most of the main producing MS are presented in Table EQ1.6. It reveals the lack of uniformity in the direction of the area changes after 2003. (The UK is not included as no regional data were available after 2004.)

Table EQ1.6: Changes in protein crop area in the main producing MS by NUTS 1 region

	2000 -2003		2004 -2007		Changes in area	
Germany	**'000 ha**	**% of total**	**'000 ha**	**% of total**	**'000 ha**	**in share**
Baden-Württemberg	7.8	3.8%	5.4	3.6%	-2.4	-0.2%
Bayern	16.9	8.2%	16.7	11.2%	-0.2	3.0%
Brandenburg	41.9	20.5%	33.5	22.5%	-8.5	2.1%
Hessen	8.5	4.2%	5.5	3.7%	-3.0	-0.4%
Mecklenburg-Vorpommern	19.5	9.5%	11.0	7.4%	-8.5	-2.1%
Niedersachsen	9.1	4.4%	6.1	4.1%	-3.1	-0.4%
Nordrhein-Westfalen	5.6	2.7%	6.3	4.2%	0.7	1.5%
Rheinland-Pfalz	5.1	2.5%	2.5	1.7%	-2.6	-0.8%
Saarland	0.5	0.2%	0.3	0.2%	-0.2	0.0%
Sachsen	23.3	11.4%	15.9	10.7%	-7.4	-0.7%
Sachsen-Anhalt	43.5	21.2%	27.2	18.3%	-16.3	-2.9%
Schleswig-Holstein	2.7	1.3%	2.3	1.5%	-0.4	0.2%
Thüringen	20.6	10.1%	17.4	11.7%	-3.3	1.6%
Spain	**'000 ha**	**% of total**	**'000 ha**	**% of total**	**'000 ha**	**in share**
Noroeste	6.1	1.2%	5.1	1.1%	-1.0	-0.2%
Noreste	45.3	9.2%	32.8	6.7%	-12.4	-2.5%
Comunidad de Madrid	8.1	1.7%	9.1	1.9%	1.0	0.2%
Centro	355.1	72.5%	355.7	72.9%	0.6	0.4%
Este	10.8	2.2%	9.6	2.0%	-1.2	-0.2%
Sur	63.9	13.0%	75.1	15.4%	11.3	2.4%
Canarias	0.3	0.1%	0.3	0.1%	0.0	0.0%
France	**'000 ha**	**% of total**	**'000 ha**	**% of total**	**'000 ha**	**in share**
Île de France	41.2	8.8%	40.2	11.0%	-1.0	2.2%
Bassin Parisien	278.6	59.8%	213.9	58.7%	-64.7	-1.1%
Nord - Pas-de-Calais	21.0	4.5%	16.4	4.5%	-4.6	0.0%
Est	4.5	1.0%	5.5	1.5%	1.0	0.5%
Ouest	62.3	13.4%	42.6	11.7%	-19.7	-1.7%
Sud-Ouest	36.6	7.9%	28.7	7.9%	-7.9	0.0%
Centre-Est	16.3	3.5%	11.3	3.1%	-5.0	-0.4%
Méditerranée	5.6	1.2%	5.7	1.6%	0.0	0.4%
French overseas departments (FR)	0.0	0.0%	0.0	0.0%	0.0	0.0%
Italy	**'000 ha**	**% of total**	**'000 ha**	**% of total**	**'000 ha**	**in share**
Nord Ovest	1.1	10.1%	0.6	32.5%	-0.5	22.4%
Nord Est	12.5	4.0%	7.6	6.5%	-4.9	2.5%
Centro	15.2	15.6%	14.8	13.4%	-0.4	-2.2%
Sud	68.4	36.8%	79.3	25.9%	10.9	-11.0%
Isole	6.9	33.5%	25.8	21.8%	18.9	-11.7%
Poland	**'000 ha**	**% of total**	**'000 ha**	**% of total**	**'000 ha**	**in share**
Centralny	10.7	14.2%	10.6	14.9%	-0.1	0.7%
Poludniowy	25.2	3.9%	20.5	5.3%	-4.7	1.3%
Wschodni	22.9	31.3%	17.3	37.6%	-5.7	6.3%
Pólnocno-Zachodni	105.7	16.4%	120.7	15.9%	15.0	-0.5%
Poludniowo-Zachodni	15.0	4.3%	18.0	4.7%	3.0	0.4%
Pólnocny	4.2	29.9%	6.4	21.5%	2.2	-8.3%

Source: Eurostat.

Note: Data for Spain are only available up to 2006. Data are not available for the UK after 2004, and so it is excluded. For Germany, the Stadtländer, namely Berlin, Bremen and Hamburg, do not appear in the table as virtually no agricultural activities are carried out in these regions.

4. Effects of other CAP measures on protein crop areas

This section investigates the impact of other CAP measures on the areas planted to protein crops in the evaluation period. The measures in this analysis are CAP measures promoting non-food/non-feed uses of COP crops, and measures ending coupled aid for grain legumes.

4.1. Effects of CAP measures promoting non-food/non-feed uses of COP crops

In order to assess whether these two separate sets of measures, COP plantings on set-aside land and energy crop plantings, might explain the decline in the share of protein crops in total COP areas, we prepared Table EQ1.7. This table describes the proportional changes in protein crops areas, using the definitions employed in Table EQ1.5, from 2000-2003 to 2004-2008. The new element in the table is to take account of COP areas cultivated on set-aside land or with the benefit of energy crop measures, and then to compute the protein crop shares of solely those COP areas which did not fall into either of the two categories just mentioned.

One hypothesis that could explain the decrease, on average, in the protein crop share of total COP crop areas is that the areas planted to COP crops on set-aside land for non-food/non-feed uses and those areas benefiting from energy crop payments of €45 per hectare, which were introduced in 2004, may have increased at the expense of protein crops, and so were a major factor behind the declines observed in the shares committed to protein crops. The hypothesis, therefore, being tested is that the declines in protein crop areas may be caused to a significant degree by CAP measures that encouraged COP crop plantings for non-food/non-feed uses.

Table EQ1.7: Proportional changes in protein crop shares of EU-15 COP crop areas after the 2003 reform, with and without areas for non-food set-aside and energy crops

	Protein crop of total COP	% share excl. COP energy & set-aside	*Field pea of total COP*	*% share excl. COP energy & set-aside*	*Field bean of total COP*	*% share excl. COP energy & set-aside*	*Sweet lupin of total COP*	*% share excl. COP energy & set-aside*
2000-2003	2.8%	2.9%	*1.9%*	*1.9%*	*0.8%*	*0.8%*	*0.2%*	*0.2%*
2004-2008	2.4%	2.5%	*1.4%*	*1.5%*	*0.9%*	*0.9%*	*0.1%*	*0.1%*
Proportional change	-14.2%	-12.5%	*-24.7%*	*-23.2%*	*11.3%*	*13.6%*	*-13.5%*	*-11.7%*

Sources: Derived from DG Agri; and preceding tables

Note: "Proportional change to 2008/09" measures relative changes in the % of the COP area over the relevant period. For example, a fall from 2.5% to 1.3% would yield a value of -48% (1.3 being 52% of 2.5).
The areas of COP crops that are planted for non-food uses on set-aside land and those in receipt of the energy crop payment are excluded from the total COP area when computing the protein crop share in the second column in each pair of columns. It is assumed that the energy crop area in 2008/09 is the same as in 2007/08.

In Table EQ1.7, two separate ways of expressing changes in protein crop shares are contrasted. The left hand column repeats the results presented in Table EQ1.5. The right hand column in each pair being compared relates only to the COP areas excluding both all the areas that were planted on set-aside land and all the areas receiving energy crop payments. We see that the proportional reduction in the protein crop share of total COP areas in the EU-15 after the 2003 reform was 14.2%. However, if we analyse solely the area of COP crops that were not planted on set-aside land and exclude also those that received energy crop payments, there was still a proportional reduction in the protein crop share, but a slightly smaller one of 12.5%.

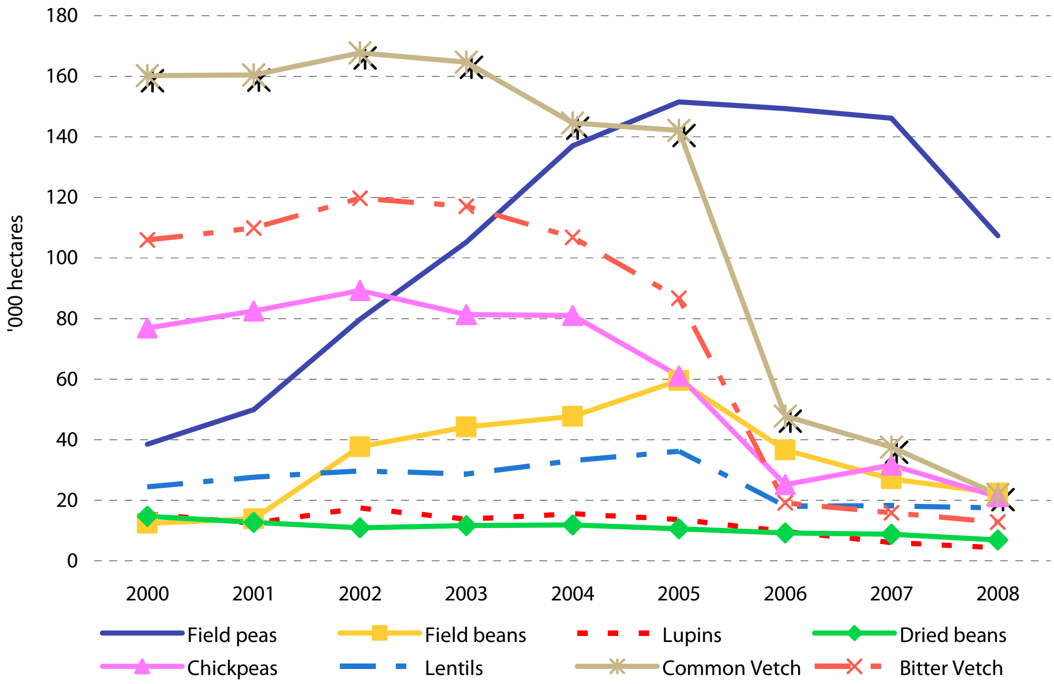
12.5% is still a significant decline in the protein crop share. Thus, we conclude that the development of measures to promote non-food/non-feed crop cultivation, particularly within the framework of energy crop measures, was only a small factor explaining the reduction in the protein crop percentage of total COP areas in the EU-15 after the 2003 reform.

4.2 Effects of the ending of the coupled aids for grain legumes

The 2003 reforms ended the coupled aid of a maximum of €181 per hectare paid for grain legumes (chick peas, lentils and vetches, both the bitter and sweet varieties)[32]. Maximum guaranteed areas had been set by MS, with only Greece, Spain and France among the EU-15 entitled to the aid, and with Spain receiving the largest share. In 2005, the last year before coupled aids on grain legumes were incorporated into the SPS scheme, aids were paid on 315,600 hectares in Spain, 7,130 hectares in France and 4,300 hectares in Greece

One hypothesis that might explain the rise in Spanish field pea areas after the reform (see Tables EQ1.2 and EQ1.5), when compared with most other EU-15 MS, is that some of the grain legume area may have switched to protein crops after coupled grain legume aids ceased in 2005. One reason, apart from the change in the relativities of coupled aids between the two crops, would be that they both are valuable in a rotation and are nitrogen-fixing crops. To examine this hypothesis, therefore, we have prepared Diagram EQ1.2, which plots the evolution of individual protein crop and grain legume crop areas in Spain since 2000.

Diagram EQ1.2: Areas planted to protein crops and grain legumes in Spain, 2000-2008



Source: DG Agri, FAO, COPA-COGECA, MARA

The diagram provides evidence that there was some substitution of field pea and bean areas for grain legume areas from 2002 to 2005. However, from 2006, when grain legume coupled payments ceased, the area under grain legumes fell sharply, and yet the protein crop area also declined. In other words, field pea and bean areas expanded <u>before</u> coupled payments on grain legumes ended, and <u>both</u> protein crop and grain legume areas declined after 2005.

We conclude that the end of the grain legume coupled aid was unlikely to have been the main factor behind the changes that occurred in protein crop areas in Spain after the 2003 reform, and in particular after 2005, when the grain legume coupled aids ceased.

[32] The measure that reformed grain legume aids was Art. 141, EC Regulation 1782/2003.

5. Effects of the 2003 reform on protein crop yields

Detailed analysis of trends in EU protein crop yields was presented in Chapter 3. One major conclusion from that analysis was that average EU-27 yields of field peas and sweet lupins fell significantly from their respective peaks in 1999 and 2001, but were stable for field beans. In this section, we investigate possible causes of the declining trend in yields for protein crops.

5.1. Changes in input use

One hypothesis that we considered in our investigation is that farmers reduced their input use following the reforms, thereby lowering protein crop yields. We have analysed this hypothesis from the responses to the producer questionnaires completed during the course of the six case studies.

These revealed no evidence of a significant change in the use of most major inputs between 2003 and 2008. For fertilisers, for example, 11% of the producers interviewed said that they increased their fertiliser use per hectare; 12% said they reduced it; 41% stated that there was no change; the remaining 36% did not answer this question. The sole input where there is an indication of a possible significant change in the intensity of input use since the reform was in seed application rates; 24% reported an increase in use and 7% a decrease.

Trends in input use would be expected to be linked to changes in agricultural input prices. In recent years, higher input prices have raised production costs per hectare for most crops. It is hypothesised that protein crops, by virtue of their nitrogen-fixing properties, have been able to avoid some of these input cost increases. This hypothesis is supported by the data in Table EQ1.8, which reviews the changes between 2001-2003 and 2004-2006 in average direct production costs per hectare for field peas and beans and for the main alternative cereal and oilseed crops, namely common wheat, rapeseed and (for Castilla-La Mancha alone) sunflower.

Table EQ1.8: Direct production costs of COP crops, 2001-2003 vs. 2004-2006 (€/ha)

		2001-2003	2004-2006	Change
Field peas	Seine Maritime	405	429	5.8%
	Eure et Loir	281	263	-6.4%
	Castilla-La Mancha	245	289	18.0%
	Niedersachsen	313	306	-2.1%
	East Anglia	307	306	-0.6%
			Average	***2.9%***
Field beans	Niedersachsen	279	310	11.1%
	East Anglia	206	201	-2.5%
			Average	***4.3%***
Common wheat	Seine Maritime	348	371	6.6%
	Eure et Loir	328	341	4.0%
	Castilla-La Mancha	270	296	9.7%
	Niedersachsen	552	577	4.4%
	East Anglia	400	399	-0.2%
			Average	***4.9%***
Rapeseed	Seine Maritime	337	394	16.9%
	Eure et Loir	333	359	7.7%
	Niedersachsen	545	601	10.3%
	East Anglia	357	371	3.9%
			Average	***9.7%***
Sunflower	Castilla-La Mancha	158	174	9.9%

Sources: Case study monographs derived from national databases

In the table, direct costs per hectare comprise specific costs, as defined by FADN. This includes the cost of seeds, fertilisers and chemicals, but not of labour or machinery.

The Spanish case study data included depreciation within the primary direct cost figures. To ensure full consistency with other case studies, a depreciation estimate was subtracted from the data used in the analysis. The value of depreciation was assumed to be equal to the average depreciation costs per hectare from the FADN database for all protein crop producers in the group of COP specialists within the Centro region, the FADN region which includes Castilla-La Mancha, the area selected as a case study.

The averages listed in the table are simple arithmetic means. 2006 is the end date because not all regions have production cost data available for 2007. Also, 2006 is the most recent year for which FADN data are available on depreciation.

The average cost increase for field peas between the two periods was less than 3%. It was over 4% for field beans, close to 5% for common wheat, and almost 10% for both oilseeds. This is consistent with the hypothesis that, by virtue of their comparatively low use of fertilisers per hectare, protein crop producers benefited (or, rather, suffered less), when compared with other COP crop producers, from rises in input prices after the 2003 reform.

5.2. Shift in the geographical distribution of protein crop area

An alternative possible explanation of the poor trend in average EU-15 protein crop yields was that the 2003 measures, by applying a fixed special aid per hectare for protein crops of €55.57, encouraged protein crop production in MS with lower than average reference yields, while conversely discouraging it in MS with higher than average reference yields.

The reasoning behind this hypothesis is that protein crop production in the MS with below average reference yields would have received a higher differential per hectare between their coupled payments per hectare of protein crops and the coupled payments made per hectare of the main cereal and oilseed crops after the implementation of the 2003 measures than they would have received before the reform.

We have adopted two different methodologies to assess the validity of this hypothesis. The first focuses upon the geographical distribution of changes in protein crop areas between the EU-15 MS and is illustrated by the data depicted in Diagram EQ1.3.

The data used in this diagram are summarised in Table EQ1.9. This lists the proportional area changes (as a share of COP crop areas, applying the definition introduced in Table EQ1.5) for field peas and field beans between 2000-2003 and 2004-2008 alongside the “other cereal” reference yields for each EU-15 MS, which determined protein crop coupled area payments before the 2003 measures[33].

If the hypothesis is correct, the lines fitted to the scatter diagrams would slope downwards, indicating that the highest relative increases in protein crop areas tended to occur in regions with lower than average reference yields (those plotted on the left hand side of the diagram), and the largest declines tend to occur in regions with higher than average reference yields (those plotted on the right hand side of the diagram).

[33] The linear relationship for sweet lupins, which relates to only six EU-15 MS, has an adjusted R^2 of -0.126, and F significance of 0.592. The slope coefficient on the reference yield term was positive (0.432), contradicting the hypothesis, but the t-value was only 0.57, confirming the conclusion from the other diagnostics that the results for sweet lupins were not statistically significant.

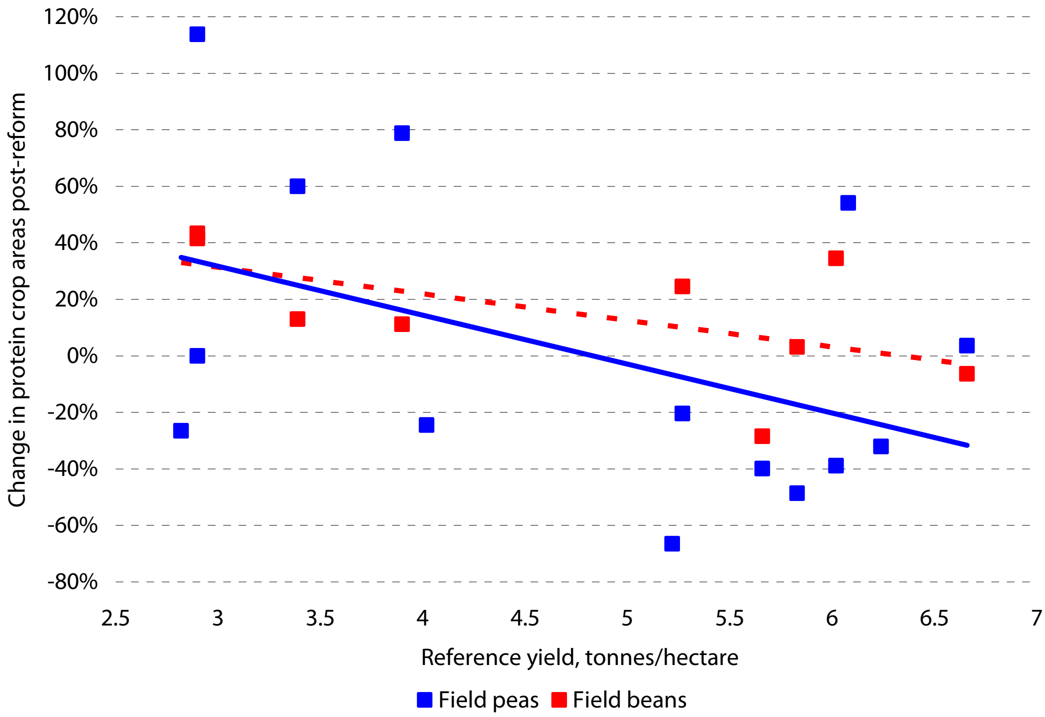
In Diagram EQ1.3, the diagnostic values for parameters such as the adjusted R^2 indicate that, where a linear relationship is applied, a very small proportion of the total variation in the dependent variable (the changes in the protein crop area after 2003 for field peas and field beans) is explained by differences in the explanatory variable (the reference yields).

The adjusted R^2 is 10.8% for field peas, and negative for field beans, and the t-values for the slope coefficients, are 0.50 and 1.57, respectively, which are not statistically significant at a 95% level. Therefore, no statistical significance can be attached to the downward slope implied by the lines. Instead, we conclude that virtually all the variation between the outcomes by MS is accounted for by factors other than the reference yield.

We observe from the table that:

- Among MS with lower than average reference yields, two (Spain and Italy) recorded the largest growth in field pea and bean areas in both absolute and relative terms. In Greece and Portugal, areas remained fairly stable, but they declined in Finland.
- Field pea areas fell sharply, both in absolute and relative terms, in Germany, France and the UK (all with above-average yields). All other countries with higher than reference yields, apart from the Netherlands, also saw their area decline. For field beans, the outcome among countries with higher than average reference yields was more mixed.

Diagram EQ1.3: Relative changes in protein crop areas from 2000-2003 to 2004-2008 vs. reference yields in EU-15 member states



Source: DG Agri; FAO.

% Relative change in field pea area = 0.80 - 0.17 Reference yield

(t-value 1.48) (t-value 1.57)

Adjusted R^2 = 0.108 Significance F = 0.145

% Relative change in field bean area = 0.21 - 0.03 Reference yield

(t-value 0.76) (t-value 0.50)

Adjusted R^2 = -0.103 Significance F = 0.630

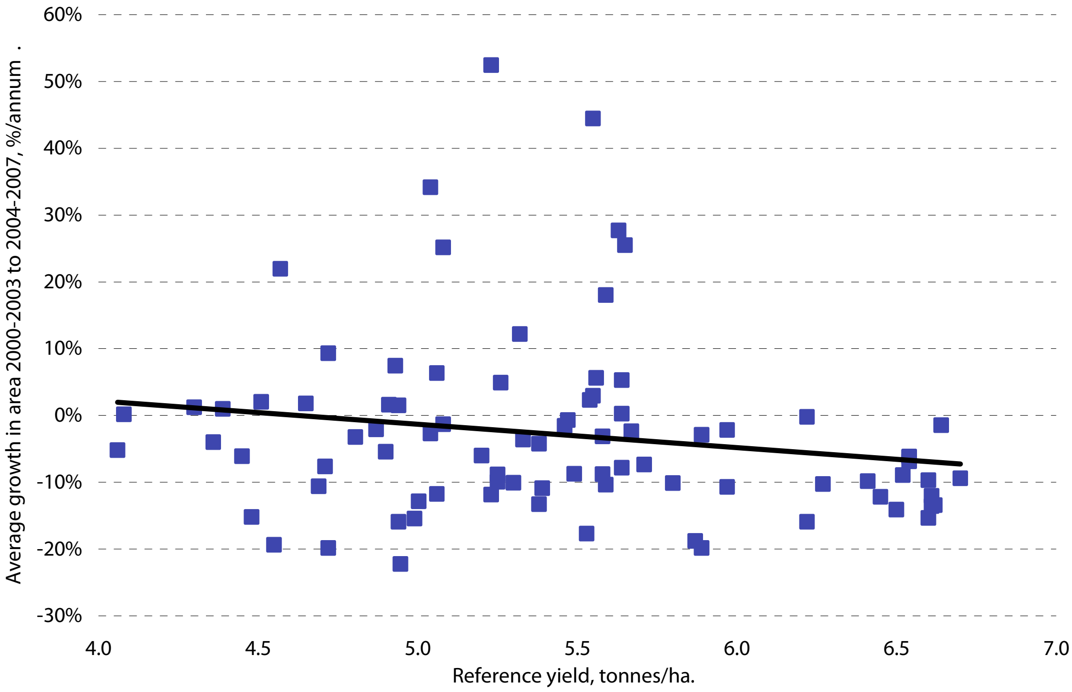
Table EQ1.9: Absolute and percentage changes in field pea and field bean area (2004-2008 vs. 2000-2003) by EU-15 MS vs. reference yields for "Other cereals"

	Field Peas		Field Beans		Reference yields
	Absolute change '000 hectares	% change	Absolute change '000 hectares	% change	Other cereals tonnes/hectare
Belgium-Lux	-0.6	-28%	0.1		6.24
Denmark	-22.1	-67%	0.0		5.22
Germany	-59.4	-40%	-5.6	-29%	5.66
Greece	0.1	40%	0.0	-1%	3.39
Spain	73.6	107%	10.2	39%	2.90
France	-147.8	-38%	20.2	37%	6.02
Ireland	0.3	54%	0.0		6.24
Italy	5.0	70%	2.7	6%	3.90
Netherlands	0.1	5%	0.0	-5%	6.66
Austria	-9.2	-22%	0.7	21%	5.27
Portugal	0.0		-0.3	-1%	2.90
Finland	-1.3	-26%	0.0		2.82
Sweden	-9.2	-31%	0.0		4.02
UK	-40.7	-49%	2.4	2%	5.83

Source: DG Agri; FAO; COPA-COGECA and Prolea (the latter two are the basis for 2008-09 estimates for protein crops).
Note: No field bean production was recorded in Belgium-Luxembourg prior to 2004.
The reference yield for "other cereals" averaged over the EU 15 is 4.68 tonnes per hectare.

The outcome of the analysis presented in Diagram EQ1.3 is consistent with similar analysis of French field pea area changes by *département*, plotted in Diagram EQ 1.4, from the data listed in Table EQ1.10

Diagram EQ1.4: Average annual growth in field pea areas, 2000-2003 to 2004-2007, vs. reference yields under the French regionalisation plan by *département*



Source: SSP, Statistique Agricole Annuelle

% change in field pea area 2000-2003 to 2004-2007 = 0.162 – 0.035 Reference yield

(t-value 1.38) (t-value 1.64)

Adjusted R^2 = .020 Significance F = 0.105

In Diagram EQ 1.4, the adjusted R^2 value at 2.0% indicates that the share of the total variation in the field pea area explained by regional reference yields is negligible. Most of the variation is accounted for by other factors.

The slope coefficient is estimated at -.035, but the t-Statistic value for this coefficient is 1.64, indicating that the value of this coefficient is not statistically significant at a 95% confidence level. This is confirmed by the F significance of 0.105, which indicates that the reference yield has no statistically significant effect on the growth in the field area at a 95% confidence level.

Table EQ1.10 : Reference yields and changes in field pea areas, 2000-2003 to 2004-2007

Département		Reference yield for protein crops (t/ha)	Change in area, 2000-2003 to 2004-2007
65	Hautes-Pyrénées	4.57	21.9%
43	Haute-Loire	4.95	-22.2%
07	Ardèche	4.48	-15.2%
84	Vaucluse	4.65	1.8%
48	Lozère	4.36	-4.0%
13	Bouches-du-Rhône	4.51	2.0%
05	Hautes-Alpes	4.72	9.3%
12	Aveyron	4.72	-19.8%
47	Lot-et-Garonne	5.06	-11.8%
23	Creuse	4.94	1.5%
81	Tarn	4.99	-15.5%
04	Alpes-de-Haute-Provence	4.30	1.2%
87	Haute-Vienne	4.94	-15.9%
09	Ariège	4.71	-7.6%
30	Gard	4.45	-6.1%
46	Lot	4.81	-3.2%
39	Jura	5.06	6.3%
64	Pyrénées-Atlantiques	5.08	25.1%
40	Landes	5.04	34.1%
24	Dordogne	4.91	1.6%
70	Haute-Saone	5.55	44.5%
33	Gironde	4.93	7.5%
32	Gers	5.08	-1.3%
34	Herault	4.06	-5.2%
42	Loire	5.00	-12.9%
26	Drôme	4.69	-10.6%
82	Tarn-et-Garonne	4.90	-5.5%
03	Allier	5.25	-9.9%
44	Loire-Atlantique	5.25	-8.8%
31	Haute-Garonne	4.87	-2.1%
83	Var	4.08	0.2%
19	Corrèze	4.55	-19.4%
63	Puy-de-Dôme	5.39	-10.9%
50	Manche	5.71	-7.4%
74	Haute-Savoie	5.32	12.2%
11	Aude	4.39	1.0%
53	Mayenne	5.87	-18.8%
49	Maine-et-Loire	5.38	-4.3%
88	Vosges	5.26	4.9%
16	Charente	5.20	-6.0%
37	Indre-et-Loire	5.58	-3.1%
61	Orne	5.97	-10.7%
18	Cher	5.67	-2.4%

Table EQ1.10 (Continued): Reference yields and changes in field pea areas, 2000-2003 to 2004-2007

	Departement	Reference yield for protein crops (t/ha)	Change in area, 2000-2003 to 2004-2007
52	Haute-Marne	5.59	18.0%
58	Nièvre	5.54	2.3%
55	Meuse	5.65	25.5%
57	Moselle	5.55	2.9%
36	Indre	5.46	-1.6%
72	Sarthe	5.64	-7.8%
71	Saône-et-Loire	5.04	-2.7%
89	Yonne	5.97	-2.2%
01	Ain	5.58	-8.8%
54	Meurthe-et-Moselle	5.64	5.3%
35	Ille-et-Vilaine	5.53	-17.7%
69	Rhône	5.23	-11.9%
85	Vendée	5.49	-8.8%
56	Morbihan	5.59	-10.4%
21	Côte-d'Or	5.64	0.3%
41	Loir-et-Cher	5.80	-10.1%
28	Eure-et-Loir	6.27	-10.3%
79	Deux-Sèvres	5.33	-3.6%
86	Vienne	5.38	-13.3%
73	Savoie	5.23	52.4%
38	Isère	5.30	-10.1%
10	Aube	6.50	-14.1%
68	Haut-Rhin	5.63	27.7%
08	Ardennes	6.22	-15.9%
51	Marne	6.60	-9.7%
22	Côtes-d'Armor	5.89	-19.9%
14	Calvados	6.45	-12.2%
02	Aisne	6.62	-13.5%
17	Charente-Maritime	5.47	-0.7%
93	Seine-Saint-Denis	6.64	-1.5%
29	Finistère	5.56	5.6%
45	Loiret	5.89	-2.9%
59	Nord	6.61	-12.1%
78	Yvelines	6.52	-8.9%
91	Essonne	6.22	-0.2%
60	Oise	6.54	-6.2%
80	Somme	6.70	-9.4%
27	Eure	6.41	-9.8%
95	Val-d'Oise	6.54	-6.2%
62	Pas-de-Calais	6.60	-15.3%
77	Seine-et-Marne	6.54	-6.9%
76	Seine-Maritime	6.61	-13.6%

Sources : SSP and UNIP

An alternative methodology to assess whether changes in average EU-15 yields can be attributed to changes in the geographical distribution of COP crop areas by MS is by simulating the effect of holding the distribution by MS of areas of all COP crops (including protein crops) fixed at 2000 levels, (i.e., crop areas are assumed to be fixed at 2000 areas), while allowing national yields to shift in the manner that they did in practice over time.

A comparison between the exponential trends in yields from 2000 to 2007 implied by the results of this simulation and the actual exponential trends in yields is presented in Diagram EQ1.5. Differences may be interpreted as the impact of shifts in planted areas between MS.

Diagram EQ1.5 contrasts, in blue, actual average EU-15 yield changes for the leading COP crops since 2000 (plotted in Diagram 3.11) with the trend levels of the changes in yields that would have resulted if the areas of protein crops and other arable crops by MS had not changed since 2000[34]. The former thus represents trends in yields on actual areas each year, while the latter holds the areas by MS fixed at their 2000 levels every year, but applies the actual yields recorded each year in each MS. The difference between the two sets of estimates may be attributed to the changing geographical distribution of production between MS.

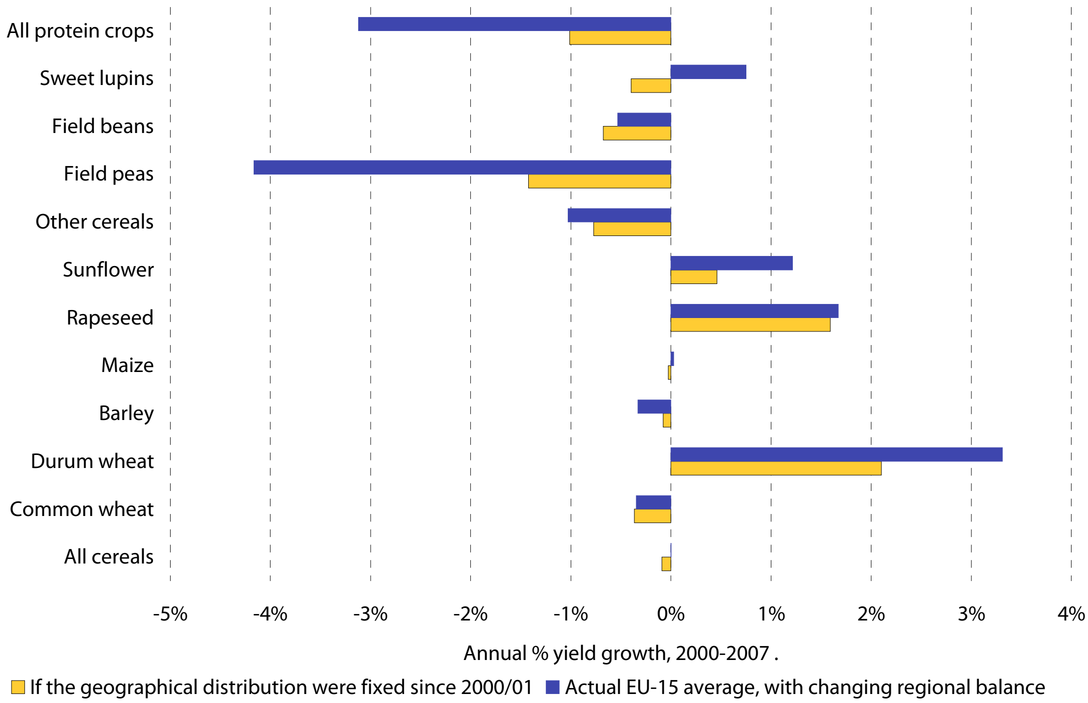
These results must be interpreted with caution in the light of the *ceteris paribus* assumption, whereby we assume that all other factors that could have affected the geographical distribution of protein crop production remained constant.

The comparison in Diagram EQ1.5 reveals that field peas would still have had the worst yield trend of any major COP crop, but, instead of an annual yield decline of over 4% for field peas from 2000 to 2007, the decline would have been one of approximately 1.5% per annum.

We have examined whether this decline was due to the fall in French areas. If the same calculation is made excluding France, the figures are quite similar. The annual yield decline for field peas would have been 4.9% in the case where planted areas follow the actual figures, as against one of only 0.8% if the area by MS had been held fixed at 2000 levels. This suggests that the results depicted in the diagram are not unduly affected by the experience of France.

If the distribution of sweet lupin areas by MS had not altered after 2000, instead of a rising yield trend, the trend would actually have been negative. For field beans, the trend in the simulation remains downwards, but its rate of decrease is slightly smaller in magnitude.

Diagram EQ1.5: EU-15 yield growth rates for protein and other arable crops, 2000-2007, comparing actual trends with trends if the geographical distribution had not altered



Source: FAO, DG Agri

Note: This depicts the results of fitting an exponential trend to yields in 2000-2007, which is why the results differ from those implied by Table EQ 1.8.

[34] This means that, while crop yields by MS in the simulation depicted in yellow reflect actual yields, the areas under the various crops in this simulation are assumed to be fixed at their 2000/01 levels.

Among the alternative COP crops, the one that performs worst in the simulation is "other cereals" (mainly rye and oats). Their average yields would have declined at a slightly smaller average annual rate than the rate estimated for protein crops as a whole in the simulation.

This analysis reveals that one potential explanation for the change in yields for field peas and for protein crops as a whole is a geographical shift in area distribution between MS, with the relative importance of low yielding areas increasing at the expense of high yielding areas. For field beans, however, this simulation implies that a slight shift occurred towards higher yielding regions; for sweet lupins, a big shift occurred towards areas with higher yields.

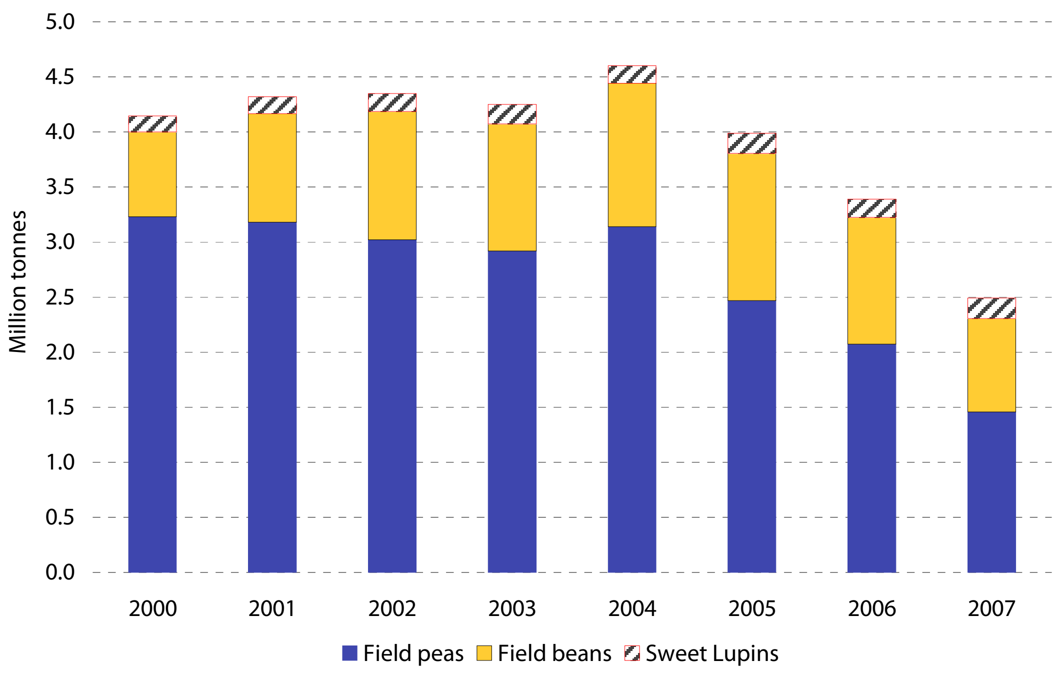
For field peas, but not field beans or sweet lupins, this is consistent with the hypothesis that the 2003 measures, by replacing payments linked to reference yields by a uniform special aid on protein crops in all EU-15 MS, stimulated protein crop plantings in regions with below-average reference yields, and discouraged them where reference yields were above average.

This result is heavily influenced by the case of Spain, which experienced a large expansion in its field pea area after 2003. Analysis of the impact of the end of coupled payments for grain legumes provided no support for the view that protein crop areas benefited from their removal. Instead, the discussion in EQ3, below, of changes in full incomes per hectare on field peas after the 2003 CAP reforms reveals that Spanish producers enjoyed an improvement in the relative profitability of field peas vs. other COP crops after full implementation of the SPS in 2006-2007. This is because the application of the uniform special aid throughout the EU-15 after 2003 raised the difference between coupled aids on protein and other COP crops by €27 per hectare. This was an important component in the €32 income advantage for field peas over other COP crops in Castilla-La Mancha in 2006-2007 (see Table EQ3.15 for the details).

6. Effects of the 2003 reform on production

In the EU-27, total protein crop output averaged just below 4.3 million tonnes in 2000-2003. Production peaked in 2004, at around 4.6 million tonnes. Since then, total output of the three protein crops has declined steadily, falling to 2.5 million tonnes in 2007 (Diagram EQ1.6).

Diagram EQ1.6: EU-27 protein crop output



Sources: DG Agri; FAO

Table EQ1.11: Protein crop output by MS, 2000-2003 to 2004-2007 ('000 tonnes)

	Field peas			Field beans			Sweet lupins			All protein crops		
	2000-2003	2004-2007	*% Change*	2000-2003	2004-2007	*% Change*	2000-2003	2004-2007	*% Change*	2000-2003	2004-2007	*% Change*
Belgium-Lux	8	6	*-32.3%*	0	0		0	0		8	6	*-32.3%*
Denmark	123	43	*-65.1%*	0	0		0	0		123	43	*-65.1%*
Germany	443	325	*-26.8%*	67	53	*-21.6%*	84	89	*5.4%*	595	466	*-21.7%*
Greece	0	1	*120.6%*	4	4	*-7.3%*	0	0	*-14.2%*	5	5	*3.4%*
Spain	90	176	*96.6%*	31	48	*57.6%*	10	7	*-33.1%*	131	231	*77.1%*
France	1,719	1,166	*-32.2%*	204	317	*55.8%*	32	17	*-45.7%*	1,954	1,501	*-23.2%*
Ireland	3	4	*68.0%*	0	0		0	0		3	4	*68.0%*
Italy	21	37	*73.1%*	67	87	*29.4%*	5	5	*-3.3%*	93	129	*37.7%*
Netherlands	8	8	*3.7%*	4	3	*-19.0%*	0	0		11	11	*-3.6%*
Austria	99	90	*-9.2%*	8	10	*23.0%*	1	1	*83.7%*	108	101	*-6.2%*
Portugal	0	0		15	17	*11.7%*	0	0	*12.5%*	15	17	*11.7%*
Finland	11	8	*-25.4%*	0	0		0	0		11	8	*-25.4%*
Sweden	77	61	*-21.1%*	0	0		0	0		77	61	*-21.1%*
UK	270	134	*-50.6%*	591	590	*-0.2%*	11	13	*16.3%*	872	736	*-15.6%*
EU-15	***2,872***	***2,058***	***-28.4%***	***990***	***1,128***	***14.0%***	***143***	***132***	***-7.6%***	***4,005***	***3,318***	***-17.2%***
Cyprus	0	0		0	0	*8.0%*	0	0		0	0	*8.0%*
Czech Rep	67	70	*4.6%*	4	5	*26.3%*	0	0		71	75	*5.9%*
Estonia	5	6	*19.3%*	0	0		0	0		5	6	*19.3%*
Hungary	48	52	*8.4%*	2	2	*-32.8%*	1	0	*-21.2%*	51	54	*6.0%*
Latvia	3	2	*-38.6%*	0	0		0	0	*-70.0%*	3	2	*-39.5%*
Lithuania	35	21	*-39.9%*	0	0		2	5	*164.9%*	37	26	*-29.1%*
Malta	0	0		1	1	*11.8%*	0	0		1	1	*11.8%*
Poland	11	10	*-10.5%*	21	20	*-2.8%*	15	36	*137.8%*	47	66	*41.1%*
Slovakia	21	25	*15.6%*	1	2	*131.2%*	0	1		22	27	*23.5%*
Slovenia	0	5	*1262.5%*	0	0	*775.0%*	0	0		0	5	*1259.8%*
Bulgaria	7	3	*-53.1%*	0	0	*30.6%*	0	2		7	5	*-25.4%*
Romania	20	37	*85.5%*	0	0		0	0		20	37	*85.5%*
EU-12	***217***	***230***	***6.2%***	***30***	***31***	***3.0%***	***18***	***43***	***143.6%***	***264***	***303***	***15.0%***
EU-27	**3,089**	**2,287**	**-25.9%**	**1,020**	**1,159**	**13.6%**	**161**	**175**	**9.0%**	**4,269**	**3,621**	**-15.2%**

Sources: DG Agri; FAO

Field pea output dominates protein crop output. Its share of total production declined from 72% in 2000-2003 to 62% in 2004-2007. The share of field beans in the total rose from 24% to 32% between the same periods, while sweet lupin share increased from 4% to 5%.

The changes in production of each protein crop in each MS between 2000-2003 and 2004-2007 are listed in Table EQ1.11.

- Among the larger EU-15 producers of field peas, only Spain raised its output after the reform. However, both the Czech Republic and Hungary, the two largest field pea producers in the EU-12, increased their output. Total EU-15 field pea output fell 28.4% after 2003, while the EU-12 total rose 6.8%, but the EU-27 figure fell 25.9%.

- Among EU-15 significant producers of field beans, France and Italy both increased their output after the reform, while the UK, the biggest producer of all, saw its output decline by just 0.2%. None of the EU-12 producers produced as much as 25,000 tonnes of output. The EU-15 as a whole raised its output by 14.0%. The total for the EU-12 grew by 3.0% and the EU-27 as a whole expanded 13.6%.

- The only sweet lupin producer whose output was over 50,000 tonnes was Germany, and its output increased slightly after the reform. Poland, the second largest producer, raised its production by 137.8% in 2004-2007. Total EU-15 output fell 7.6% after the reform, while the EU-12 total rose by 143.6%. The EU-27 figure grew by 9.0%.

6.1. The distribution of protein crop production by end use

The primary distinction made regarding the quality of protein crop output is by end-use, in particular, whether it is for feed or food uses. The basic feed grade of output, for use on-farm or in compound feed, is the main source of demand for all three protein crops.

Table EQ1.12: Shares of EU-27 protein crop output by end-use, 2000-2003 vs. 2004-2008

	Field Peas	Field Peas	Field Beans	Field Beans	Sweet Lupins	Sweet Lupins
	Feed Uses	Other Uses	Feed Uses	Other Uses	Feed Uses	Other Uses
2000-2003	81.6%	18.4%	81.3%	18.7%	99.4%	0.6%
2004-2008	76.5%	23.5%	83.4%	16.6%	99.4%	0.6%

Sources: FAO, COMEXT, Case study interviews
Note: Premium grades of lupins and field beans are those used in food and processing. Premium grades of field peas are those used in food and processing, as well as pet food manufacture. These are grouped under "other uses".

Table EQ1.12 presents estimates of changes in the distribution of EU-27 output between feed and other uses. The latter comprise protein crops for food and food processing, and protein crops for pet food, notably bird and horse feed. For sweet lupins, feed is the overwhelmingly predominant end-use. For field beans, feed uses exceed other uses by a percentage that rose after the reform. For field peas, the share of sales to the feed sector declined in 2004-2008.

Outside the major bulk feed applications, protein crops are used in specialised premium feed and pet food markets, as well as in food applications. Food outlets include both direct use in cooking and indirect use in processed foods, notably in baking and in canned foods. For field peas, a vital criterion of quality in premium end-use markets is the colour of the product.

The most important food grade of field peas is yellow peas, which are popular in South Asia. Green peas are favoured in pet foods, notably for bird and horse feed. The UK has a special national demand for marrowfat peas. Field beans for food use have their main market in North Africa. The quality criteria for food and feed grades of these products require tighter tolerances for humidity, impurities and various forms of damage to protein crops in food uses. Importance is also attached to the colour and uniformity of size of the food grade products.

The importance of different end-uses varies between MS. Table EQ1.13 presents estimates for 2001-2003 (pre-reform) and after 2003 (post-reform) for France, Spain and the UK.

Table EQ1.13: Shares of field pea and bean output by end-use, France, Spain and UK

		Field peas		Field beans	
		Pre-reform	Post-reform	Pre-reform	Post-reform
France	Feed	92%	77%	45%	44%
	Food	8%	23%	55%	56%
Spain	Feed	95%	95%	97%	98%
	Food	5%	5%	3%	2%
UK	Feed		1%		65%
	Edible food		31%		35%
	Pet food		68%		0%

Sources: UNIP, MARA and PGRO.
Note: In this table end-use has been estimated for exports, as well as domestic demand.

The two MS most heavily dependent upon sales of food grade protein crops are France and the UK, but the UK is distinctive in its heavy reliance upon domestic sales of field peas for premium feed uses in pet food (including bird feed).

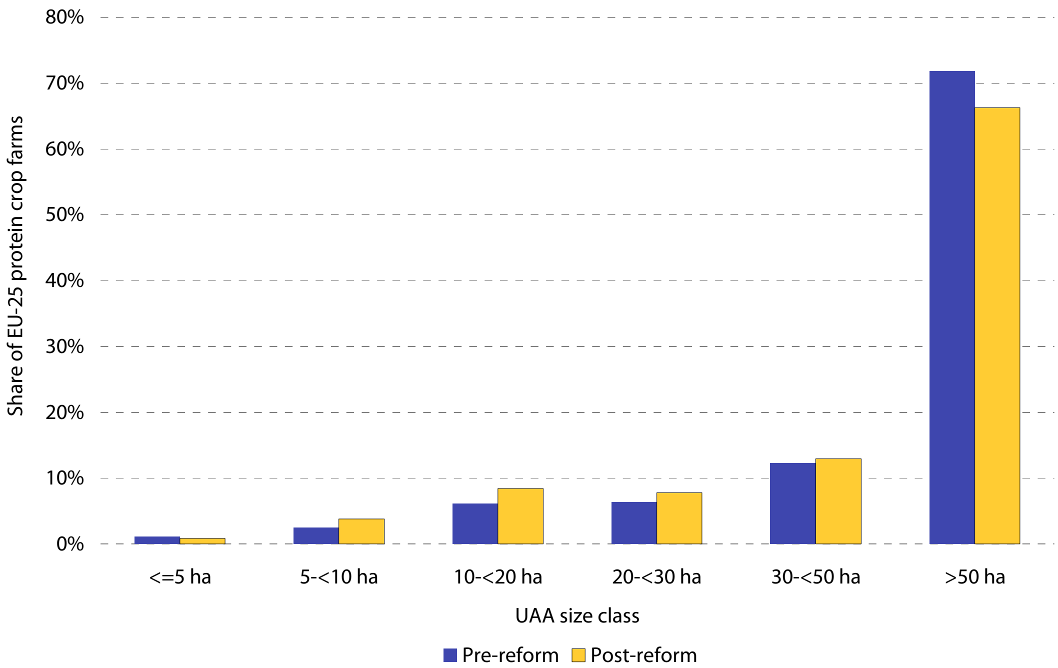
7. Effects of the 2003 reform on the structure of protein crop production

The structure of protein crop output may be analysed from FADN data using three indicators of protein crop farms: by UAA size class of holdings; by share of the farm UAA under protein crops; and by farm specialisation. The main limitations of the data are that they relate solely to the sample of producers selected by FADN[35], and that they cover the years 2000 to 2006[36], and so do not reflect the impact of the decline that occurred in protein crop areas after 2006.

The comparisons presented in the next three diagrams refer to averages for 2000-2003 and 2004-2006[37]. In terms of the size of farms growing protein crops, Diagram EQ1.7 demonstrates that these crops are mainly produced on large farms of more than 50 hectares.

Diagram EQ1.8 depicts the distribution of protein crop farms by the share of their UAA that is planted to protein crops. It reveals the low share of total farm areas committed to these crops. Overall, around two thirds of protein crop farms devote under 10% of the area to these crops.

Diagram EQ1.7: Protein crop farm distribution by size class, 2000-2003 and 2004-2006



Source: Analysis of FADN database

In terms of farm specialisation, Diagram EQ1.9 reveals that "COP specialists" are the largest single group of protein crop farms (above 30%). However, the relative importance of this type of farm has declined with around 5% since 2003. 25%-30% of total protein crop holdings are livestock farms (including field crops-grazing livestock combined; livestock producers among other types of farming; and specialist dairying). Evidence from case study interviews suggests that they are likely to grow these crops for on-farm feed.

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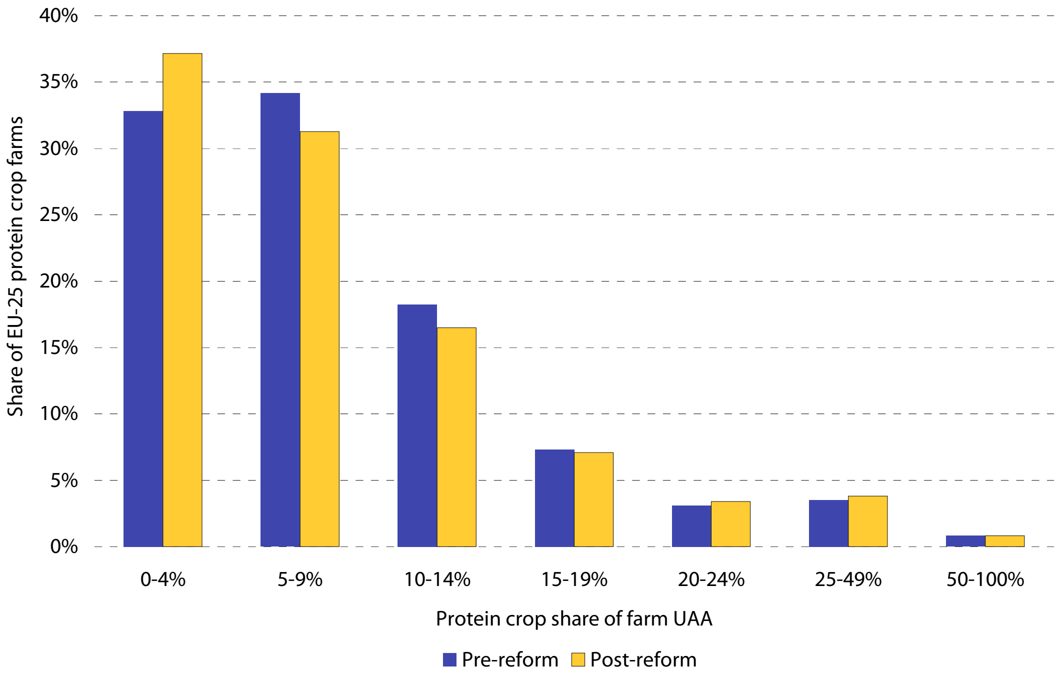
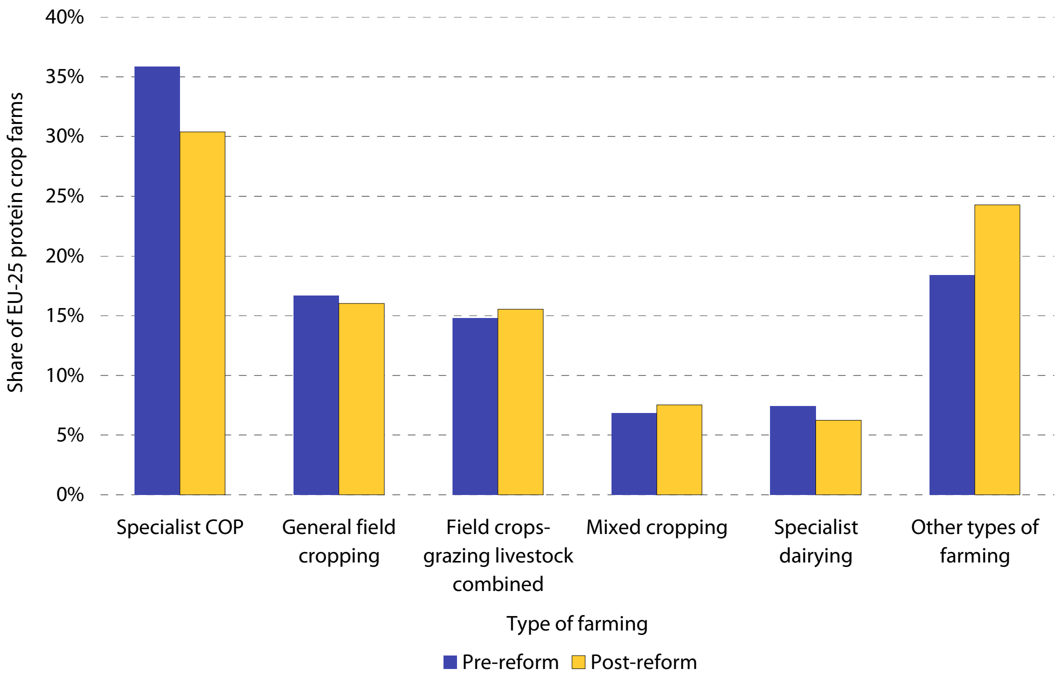
[35] The selection of farms in the FADN sample is based on three selection criteria: economic size (a measure of profitability based on the farm's standard gross margins), type of farming and region. It is important to note that farms are not selected on the basis of the type of crop/livestock produced. This means that, while the results of analysis derived from the FADN database and presented in this section give an indicative picture of the effect of the 2003 reform on the structure of the farms included in the FADN sample, these considerations cannot be used to infer the impact of the 2003 reform on the broader EU population of protein crop farms.
[36] These correspond to the crop years 2000/01 to 2006/07.
[37] The data refer to the EU-15 in 2000-2003 and EU-25 in 2004-2006. This reflects coverage in the FADN survey.

Diagram EQ1.8: Protein crop distribution by % of total UAA devoted to protein crops



Source: Analysis of FADN database

Diagram EQ1.9: Protein crop distribution by specialisation, 2000-2003 and 2004-2006



Source: Analysis of FADN database

8. Effects of the 2003 reform on protein crop prices

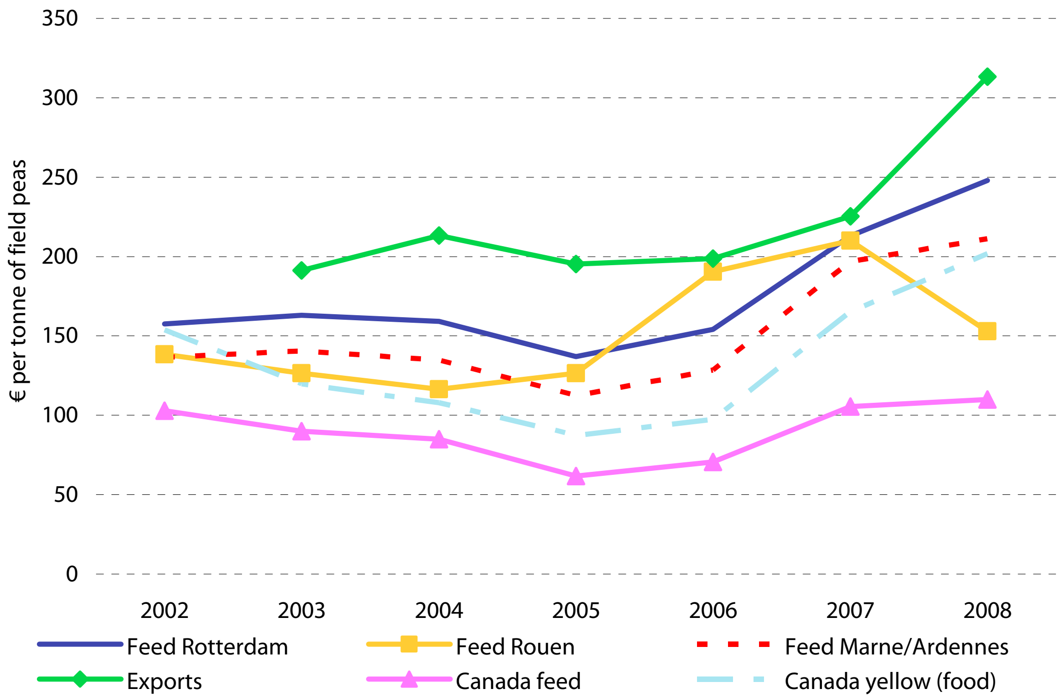
With regard to the impact of the CAP measures on prices paid for protein crops, comparisons of prices of field peas in different markets and for different qualities provides evidence of the close link between internal prices and those on the external market, while also revealing the existence of premia for higher quality products, destined for human food or pet food uses.

Diagram EQ1.10 plots annual prices for feed grade field peas in Rouen , Marne/Ardennes and Rotterdam; for feed and food grade (yellow) field peas in Canada, the main exporter; and also the unit values of extra-EU field pea exports, which are predominantly destined for food use.

- Analysis of the differential between Canadian feed grade prices and those in Rotterdam reveals that the difference in price is closely linked to the costs of freight from Canada.
- There is good evidence of the premium (which fluctuates with the volume of import demand from South Asia, as the Canadian case study reveals) paid for food grade field peas over corresponding feed grade prices, as regards both EU and Canadian exports.

Diagram EQ1.11 provides annual data on field bean and sweet lupin prices. These data are less comprehensive than those for field peas.

Diagram EQ1.10: Annual field pea prices for different grades, 2002-2008



Sources: *La Dépêche*, UNIP, LEI, COMEXT, Stat Canada

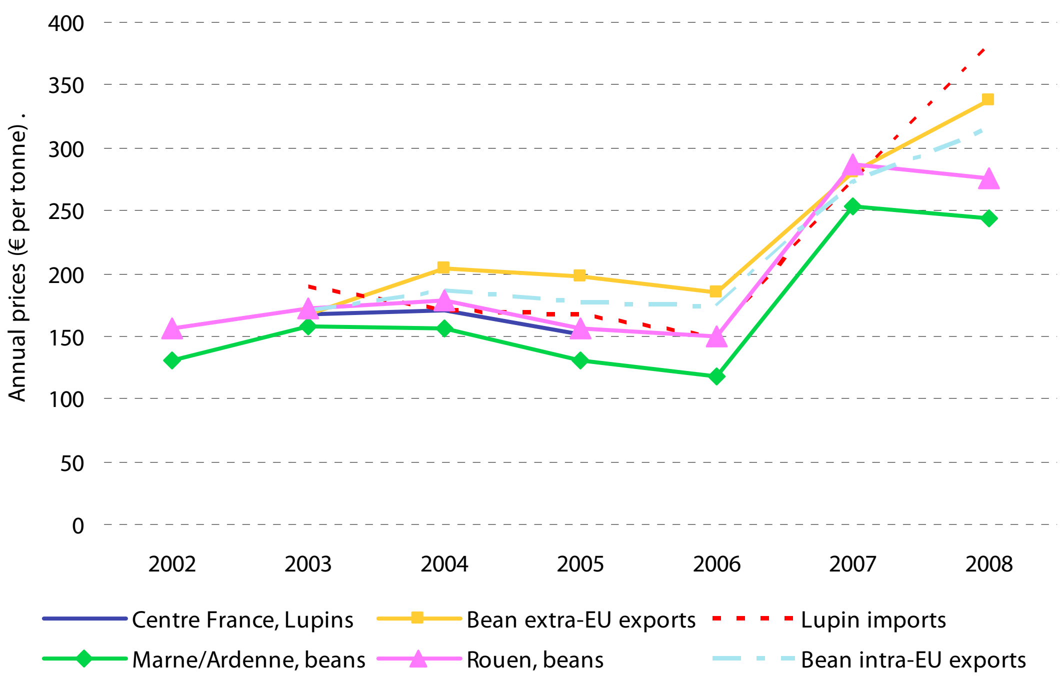
Since only a small proportion of sweet lupin output enters markets, we have only been able to obtain acceptable data on internal prices for three years. For field beans, which are more widely traded, there are long gaps in price series after the main harvest period. In interpreting the data, it should be recalled that extra-EU exports are primarily of higher quality food grade products, while internal trade is of feed grade beans. We observe from the diagram that:

- Prices of field beans trade within a fairly narrow band, but food grade extra-EU exports of field beans consistently attract a price premium.

- Sweet lupin imports supply a significant share of the local market. By virtue of their higher protein content, sweet lupins would be expected to command higher feed prices than field beans, but this is only evident in 2003 and 2008.

In terms of the impact of CAP border measures, our assessment reveals that, by minimising import tariff barriers to access for imported supplies of these crops to the EU market, the measures ensure that internal market prices are aligned to world market values, and reflect quality premia, where these apply.

Diagram EQ1.11: Annual field bean and sweet lupin prices, 2002-2008



Sources: *La Dépêche*, UNIP, COMEXT

9. Effect of the 2003 measures on protein crop producers' decisions: Evidence from questionnaires

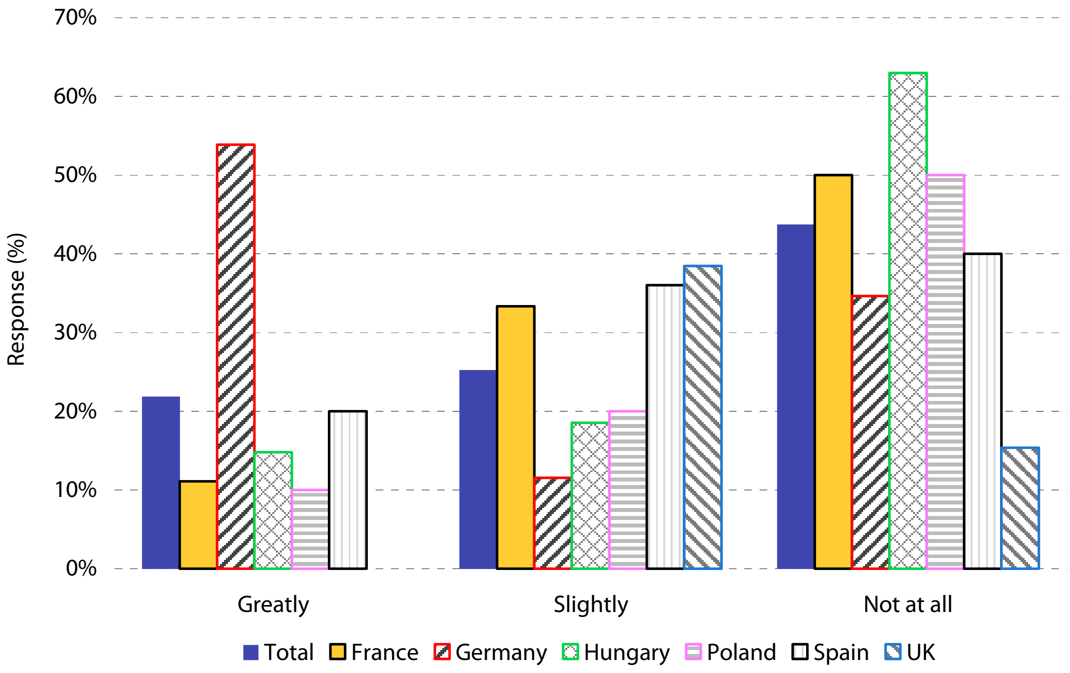
This section presents results from the questionnaires administered to protein crop farmers during the fieldwork in the six case study MS (France, Hungary, Germany, Poland, Spain and the UK). The results are summarised in Diagram EQ1.12 and indicate the extent to which protein crop producers' farming decisions have been affected by the changes brought about by the 2003 CAP reform.

When asked whether the change in the payment system (in relation to both coupled and decoupled payments) for protein crops since 2003 affected the area planted to protein crops, around half of the respondents interviewed from the EU-27 indicated that the change had had an impact on their protein crop areas. For 21% of the sample the impact was significant, while it was less pronounced for 25%. The changes in the payment system did not have any impact on the areas planted by almost 45% of the sample.

German farmers were the most affected, followed by UK farmers. For Spanish and French farmers, the impact of the changes seems to have been less severe than for their German and UK counterparts. One possible explanation for this contrast is that, unlike Germany and the UK, farmers in France and Spain continued to benefit from the partially coupled payments for arable crops in addition to the special aid for protein crops. This would have limited the effect of the change in the payment system following the 2003 reform for farmers in these MS.

Hungary and Poland as new MS were only affected by the 2003 reform through their own CNDP and SAPS schemes, and neither of their schemes included specific coupled aids for protein crops. This explains why a relatively low proportion of respondents in these two MS said that the changes in payment schemes had affected them.

Diagram EQ1.12: Effects of changes in protein crop payment schemes on planted areas



Source: Farmers' questionnaire (response rate: 91% ; in all, 108 responded to this question)

10. Conclusions

> To what extent have the CAP measures applicable to the protein crop sector affected the output of protein crops, with regard to the choice of crop, area; yield; prices paid to producers; geographical distribution?
>
> To what extent has the special aid for protein crops been an incentive to increase the production of these crops? (Special attention will be paid to impacts linked to crop rotation.)

Effects of the 2003 reform on protein crop areas. There is no doubt that EU-27 protein crop areas declined after the reform, falling from an average of 1.36 million hectares over the period 2000-2003 to 1.17 million over the period 2004-2008, and the decline has been rapid in recent years, to below 0.85 million hectares in 2008. As a result, the Maximum Guaranteed Area established in the reform was never reached. We conclude that the MGA component of the reform had no impact on protein crop areas.

The overall picture conceals different trends within the sector. Area data are available until 2008, but yield data only until 2007. By crop, comparing data for the period after 2003 with those for 2000-2003, the field pea area was down 24% and its yield down 11%; the field bean area rose 8% with a static yield; and the sweet lupin area rose 18%, though its yield fell 8%.

One potential explanation for this contrast in area trends is that field beans and sweet lupins had less yield risk than field peas, as revealed by a comparison of the coefficients of variation of their respective yields. This would have increased their attraction to risk-averse producers.

The 2003 reform, in which the special aid per hectare was set at the average level of the difference between arable aids paid on protein and "other cereal" crops, should not have caused a shift between protein and other COP crop areas for an average protein crop farmer, provided other factors were held constant. Thus, for the average producer, the balance of advantage between crops should not have been altered by the reform alone.

Exogenous factors, notably price changes in the markets for protein crops and other COP crops, adverse weather and crop diseases, were the main influences upon the declining trends in protein crop areas. None of these are attributable to the reform measures.

<u>Effects of the 2003 reform on the geographical distribution of protein crops.</u> The sector witnessed different trends with regard to both the trends in area of the individual protein crops and trends in protein crop areas for the two country groupings: EU-15 and EU-12.

The EU-15 MS areas under field peas, field beans and sweet lupins were down 26%, up 9% and down 15%, respectively, while the corresponding figures for the EU-12 MS were down 12%, down 20% and up 184%. Total EU-15 protein crop areas fell 16% after 2003, but rose 5% in the EU-12. In terms of EU-27 protein crop output, this fell from 4.3 million tonnes to 3.6 million tonnes. As noted in the context of the effects of the reform on planted areas, it is not possible to attribute this diverse outcome to the impact of the 2003 measures.

The hypothesis was analysed that the reform encouraged expansion in protein crop areas in lower yielding EU-15 regions, while discouraging it in higher yielding regions. This is because the 2003 reform introduced a uniform special aid per hectare in all EU-15 MS. This widened the gap between coupled aids on protein crops and other major COP crops in those regions with low reference yields under the measures in effect before the reform, while narrowing the gap in regions with high reference yields. *Ceteris paribus,* this should have encouraged protein crop farming to expand in areas with lower than average reference yields, and contract in those with above-average yields. The evidence from analysis of changes in the distribution of areas both by MS within the EU-15 and by region within France does not contradict this hypothesis, but there is no statistical significance in the results that are obtained. However, the field work carried out in Spain did not provide enough information to allow us to conclude what the major factors were that led to the large increase in Spanish areas planted to protein crops in the period 2004-2008 in comparison with the period 2000-2003.

<u>Effects of other CAP measures on protein crop areas.</u> Analysis undertaken of the impact of CAP measures promoting energy crop production and ending special aids for grain legumes revealed that neither explained the changes in protein crop areas satisfactorily.

<u>Effects of the 2003 reform on protein crop yields.</u> Protein crop yields depend on many external factors beyond a farmer's control, such as weather and disease. Average yields of field peas and sweet lupins after 2003 were lower than in 2000-2003; field bean yields were unchanged.

There is one hypothesis that might relate the decline in yields to the 2003 measures. This has already been mentioned in the context of the geographical distribution of protein crop areas, namely that the reform might have been expected to have encouraged plantings in regions with lower reference yields, while discouraging it in higher yielding regions. As noted above, the evidence from analysis of changes in the distribution of protein crop areas for the EU-15 and within France provides inconclusive support for this hypothesis.

Effects of the 2003 reform on protein crop output. Within the EU-27, the total output of protein crops averaged just below 4.3 million tonnes in 2000-2004. It peaked in 2004, at around 4.6 million tonnes. Since then, it has declined, to stand at 2.5 million tonnes in 2007.

In terms of individual crops, the picture was not uniform. Since output is simply the result of multiplying yields by areas, and because in the preceding analysis we could not establish a clear causal relationship between the measures applied to the protein crop sector under the 2003 CAP reform and the changes in areas and yields, we cannot conclude that the overall fall output was a direct consequence of the 2003 CAP reform.

Effects of the 2003 reform on the structure of protein crop farming. Based on analysis of the sample of protein crop farms in the FADN database, it appears that protein crops are grown mainly on the largest holdings. Where they are farmed, only a small share (typically less than 10%) of the total farm area is planted to protein crops. No significant changes in the structure of protein crop production after 2003 emerge from the same analysis.

Effects of the 2003 reform on protein crop prices. Internal prices of protein crops are closely linked to world market prices. This is mainly the result of CAP border measures (pre-dating the 2003 reform) rather than measures targeted to the protein crop sector in the 2003 CAP reform.

Chapter 5: Answer to Theme 2 Question: Impacts on the supply to the processing industry

Evaluation Question 2: Impacts on supply to the processing industry

To what extent have the CAP measures applicable to the protein crop sector influenced supplies to the compound feed industry, with regard to crop (beans, peas, sweet lupins); quantity; prices; geographical distribution?

To what extent have these supplies corresponded to the plant protein needs of the compound feed industry and influenced substitution with other plant protein sources?

The answer to this question will draw upon six main sources of data. The first is the answer to EQ1. The second is the six case studies and interviews and questionnaires answered by processors in the six MS and elsewhere in the Community. The third source of data is detailed feed ingredient analysis from specialist publications in the sector. A fourth data source is official statistics from national and international agencies regarding the use of protein inputs in the EU feed sector. A fifth source is data from the Commission on trade flows and import tariffs. The final main source of information is domestic feed ingredient prices within the EU.

The discussion follows the order of the judgement criteria listed in Table EQ2.1.

Table EQ2.1: Judgement criteria, indicators and data sources regarding processing

Judgement Criteria	Indicators	Data Sources
The significance of local protein crop supplies: by type of crop, location, area of the crop or yield of the crop for feed compounders	Statements by compounders regarding the importance of domestic sources of supply and the magnitude of such supplies	Case study interviews with national and regional feed compounding associations Processor questionnaires
Increases in the availability of alternative domestic sources of protein feeds, notably the by-products of biofuel processing	The supply of meals from locally grown oilseed crops, and of by-products from wet and dry mills processing cereals	FEFAC, AC Toepfer US Department of Agriculture Case study interviews Processor questionnaires
The availability of imported supplies of protein ingredients, both protein crops and alternative products	Import tariff structure for protein ingredients Volumes of imported sources of protein	TARIC database COMEXT, Eurostat, FEFAC AC Toepfer, US Department of Agriculture, Research institutions in Canada and Australia
The quality requirements of processors, in terms of amino-acid composition; ease of substitution, for major animal species	Statements by processors regarding the ease of substitution.	Case study interviews Processor questionnaires COMEXT
Changes in the geographical distribution of supply	Changes in the geographical distribution of feed mixing facilities by MS Supply and demand balance by MS for protein crops	FEFAC COMEXT, FAO
Changes in the relative prices of protein crops vs. alternative sources of vegetable protein	Prices of protein crops and other sources of protein ingredients Analysis of protein crop prices vs, cereal and soybean meal prices	Case study interviews Processor questionnaires National and regional sources *La filière protéagineuse, quels défis?* Edited by Guéguen & Duc, 2008
The existence of a threshold for the supply chain for individual protein crops and special quality grades	Views of processors and traders regarding indivisibilities and fixed costs in the supply chain	National and regional sources Processor interviews Producer questionnaires

1. Effects of the 2003 reform on changes in quantities and type of protein crops purchased by the feed compounding industry

There are three main determinants of the supply of protein crops to the feed compounding sector: first, domestic production of these crops; second, competition from alternative end-uses for these products; and third, the availability of imported supplies.

The impact of the CAP measures upon local protein crop output was the subject of EQ1. This revealed that, following the 2003 reform, protein crop production suffered a large decline.

In this section, we first examine how the CAP measures have affected competition from other sources of feed in the bulk feed sector. We also discuss the on-farm use of protein crops. The availability of protein crop supplies depends in part upon the ease of access to imports. This is determined by import tariffs, which we consider below. Finally, we analyse the quality requirements of feed compounders and the ease of substitution in feed uses.

1.1 . Domestic supplies of protein crops and alternative protein feeds

1.1.1. Feed use by compounders

Feed compounders choose their ingredients in terms of the relative prices and composition of alternative inputs. For protein inputs, the two most important aspects of their composition are their amino acid content and digestibility for specific animal species. Least cost linear programs determine the cheapest way to combine inputs to achieve a given composition of amino acids, carbohydrates, etc. This enables them to adapt rapidly to changes in the supply of individual inputs, such as the fall in protein crop output, by turning to alternative feeds.

The use of least cost programs means that prices of inputs cannot deviate significantly from the unit cost of mixtures of ingredients yielding the same nutrient profile. If the cost of such substitutes implies that a feed ingredient, e.g., a protein crop, has to sell at a price that causes producers to reduce their plantings, this is something to which compounders adapt without undue difficulty. Since supply and demand are determined simultaneously, this outcome may be interpreted as an indication that the drop in protein crop use was caused by a reduction in demand or that it was a result of a fall in supply; a combination of both factors is most likely.

The pattern of demand for protein ingredients from compounders has been greatly affected since 2000 by three important developments. The first was the outbreak of BSE (“mad cow disease”), which led to a ban on the use of meat and bone meal (MBM) in most major feed uses from 2001 throughout the EU.

MBM has a protein content of 50-60%, whereas field peas, field beans and ground white sweet lupin seeds have average protein contents of only 21% and 26% and 35%, respectively, as against 34% protein content in sunflower meal, 38% in rapeseed meal, 44% for standard soybean meal and 48% for dehulled (“HiPro”) soybean meal. Table EQ2.2 compares the leading sources of vegetable protein feed ingredients in terms of their three main parameters, protein, fibre and dry matter.

Prior to 2001, field peas and field beans were typically combined with MBM to yield a mixture with a protein content that was comparable to that of rapeseed or sunflower meal. This was no longer an option after 2001; thereafter, protein crops became less attractive to compounders producing feeds for pigs and poultry (the two main users of protein crops), which require a fairly high protein content.

Table EQ2.2: The protein, fibre and dry matter content of vegetable protein feeds

	Crude Protein, %	Crude Fibre, %	Dry Matter, %
De-hulled soybean meal	47.8	3.0	88.0
Soybean meal	44.0	7.0	90.0
De-hulled sunflower meal	42.0	21.0	92.0
Lupin seeds *luteus*	39.7	12.4	91.1
Rapeseed meal	38.0	11.1	91.0
Ground white lupin seeds	35.3	23.8	88.1
Sunflower meal	34.0	13.0	93.0
Lupin seeds *angustifolius*	33.2	14.1	91.1
Lentils	31.6	4.3	88.5
Maize DDGS	27.0	8.5	92.0
Field beans	25.7	8.2	89.0
Chickpeas (*garbanzo*) dried	24.6	8.9	89.0
Field peas	21.3	6.8	88.0

Source: Feedstuffs Annual Reference Issue and Buyers' Guide

Another major influence on protein crop demand in feed was the increased supply of substitute protein feeds from local oilseed crushers, either as a result of processing crops produced within the EU, among which rapeseed is increasingly important as a result of CAP energy crop measures, or from the processing of imported crops, notably soybeans. The expansion in rapeseed plantings, described in EQ1, and the increase in domestic crushing of these oilseeds made possible growth of over 90% from 6.10 million tonnes to 11.68 million tonnes in the feed uses of rapeseed meal from 2003/04 to 2008/09[38].

A further important development as a result of CAP measures since 1993 has been the decline in the internal market prices of cereals, following cuts in the cereal intervention price. Feed compounders stated in interviews that this encouraged them to substitute protein crops with mixtures of soybean meal and feed cereals in many applications[39].

From interviews with compounders, one exception was noted to the ease with which they have adapted to the declines in local protein crop supplies. Where the feed company was a cooperative, it often felt obliged to continue to buy protein crops from its members, even when supplies were declining. This raised storage costs per tonne, since segregated storage bins were needed for protein crops. Also, the marketing of these crops became harder, as it became difficult to accumulate the tonnages needed to supply large customers.

In term of protein feeds produced solely from locally grown crops, protein crops still represent a significant proportion of the total. In 2006, UNIP estimated that protein crops supplied 9% of the protein content of such ingredients. Rapeseed meal supplied 45%, sunflower meal 14% and dried fodder 10%. Soybean meal from locally grown soybeans constituted only 7% of the total.

As a share of total vegetable protein availability, however, including protein supplied from imports, as well as that derived from the processing of domestically grown crops, Chapter 3 revealed that protein crops represented only 3.7% in 2006.

[38] Source: US Department of Agriculture, October 2009.

[39] The increased use of cereals in feed after the CAP reforms in the 1990s and the significance of reductions in the cereals intervention price in promoting the greater use of cereals in this end-use were described in the *Evaluation in the Common Market Organisation in the Cereal Sector*, October 2005.

1.1.2. On-farm feed use

A special feature of the protein crop sector is the importance, notably for sweet lupins, of on-farm feed use, which is classified as feed demand, but which does not pass through industrial feed compounders. The Polish and French case study interviews revealed the significance of on-farm demand, a category that includes the retention of seeds for planting[40].

- In Poland, protein crops receive no specific coupled payment, but they share in the CNDP payment for arable crops. The largest class of protein crop output in official data is "mixtures", which consist of mixtures of 20-30% protein crops with 70-80% cereals[41]. Lupins come after such mixtures in Polish output. Both the mixtures and sweet lupins are used overwhelmingly as on-farm feed. From 2004 to 2007, mixtures represented 51% of the total area classified as protein crops; thanks to their higher yields, the mixtures accounted for 64% of the combined output over the same period.

- For France, too, a majority of sweet lupin production is consumed on-farm, as Table EQ2.3 reveals, and the proportion consumed on-farm has increased since 2000. For the other two protein crops, French on-farm use has recently been slightly above 20%, which represents a trebling of the percentage since 2000 in the case of field peas.

Table EQ2.3: Proportion of French protein crop output used on-farm, 2000-2008

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Field peas	7%	17%	15%	12%	12%	7%	14%	23%	22%
Field beans	22%	8%	24%	24%	19%	19%	26%	23%	22%
Lupins	57%	68%	82%	78%	82%	74%	73%	81%	83%

Sources: UNIP and Agreste.

Similar detailed data regarding on-farm feed use are not available for other MS, which lack the comprehensive system of data collection established by UNIP. Interviews with producers and traders in other MS revealed a consensus that on-farm feed use has been better maintained in recent years than bulk feed compounding applications, since the scale of the separate storage and handling systems that are as an issue for large compounders is not a constraint for individual farmers using crops for their own use.

In addition, the traceability of feed ingredients, which has become a matter of greater concern among retailers in recent years, is made much easier and less costly when on-farm feed is fed to livestock, and this has encouraged the use of protein crops within the farm in which they are produced.

1.2. The availability of imports of protein crops

Although domestic protein crop output has fallen, limited trade barriers mean that imports can easily be used to supplement domestic supply. Table EQ2.4 reveals the low level of import tariff barriers facing overseas suppliers in the EU market. Tariffs for MFN countries are low, and many potential suppliers enjoy preferential duty-free access for all protein crops.

Imports represent a sizeable share of total demand for field peas and sweet lupins. Table EQ2.5 describes the shares of EU demand for each protein crop supplied from net imports.

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[40] The retention of seeds for planting discourages the development of new varieties by seed companies. In 2006, the French agriculture ministry found that only 36% of the seeds for planting field peas were certified. Sweet lupins were at the other end of the spectrum, with 94% of farmers' needs bought from seed suppliers.
[41] Being mainly cereals, these mixtures are not classified as protein crops in Commission statistics.

Table EQ2.4: EU Most Favoured Nation import tariffs on protein crops

	TARIC Code	MFN Import Duty
Field peas	0713.10.90	0%
Field beans	0713.50.00.90	3.2%
Sweet lupins	1209.29.50.00	2.5%

Source: EU TARIC.

Table EQ2.5: Net imports as a % of EU-27 protein crop demand, 2000-2008 ('000 tonnes)

	2000-2003		2004-2008	
	Net imports	as % of demand	Net imports	as % of demand
Field peas	233	5.0%	567	21.3%
Field beans	6	0.5%	-180	-18.6%
Sweet lupins	277	46.9%	89	35.4%
All protein crops	516	11.0%	476	12.3%

Source: FAO, COMEXT.
Note: A negative value means that the Community was a net exporter in that year.

- For field peas, the EU is a net importer. In 2004-2008, net imports were more than 140% higher than they had been in 2000-2003. As the Canadian case study reveals, Canadian field pea availability for EU importers is sensitive to the import demand for food grade peas in the Indian sub-continent.
- Imports are a sizeable source of sweet lupin supplies. The recent fall in the import share followed a sharp drop in exports from Australia, the main origin for such imports.
- Since 2003, the EU has been a net exporter of field beans. Exports are almost entirely of food grade output, which attracts a premium over feed grade products.

Table EQ2.6: EU-27 Net Imports of Protein Feed Ingredients ('000 tonnes)

	Soybean meal	Rapeseed meal	Sunflower meal	Palm kernel meal	Corn gluten feed	Distillers' dried grains
2000-2003	19,726	49	1,600	2,396	4,004	762
As % of demand	*60.6%*	*0.8%*	*34.2%*	*99.5%*	*65.3%*	*61.7%*
2004-2007	22,209	11	1,581	2,581	2,249	602
As % of demand	*66.3%*	*0.1%*	*35.7%*	*99.7%*	*51.8%*	*51.3%*
Change in net import tonnage	12.6%	-77.3%	-1.2%	7.7%	-43.8%	-20.9%

Sources: COMEXT, DG Agri., FEFAC, AC Toepfer, USDA

Table EQ2.6 lists net imports for the major protein feeds, other than protein crops, used by the EU feed industry. It also lists net imports as a share of total EU demand for the same products, and demonstrates the very low dependence upon imports in total rapeseed meal supplies.

Soybean meal is the most important imported material. In addition, soybeans (not included in the table) are crushed for meal in the EU. After 2003, the strongest growth in net imports was in soybean meal. The largest percentage fall was for rapeseed meal, but the tonnages were very small; in 2000-2003, before their decline, they were only 0.25% of soybean meal levels.

1.3. Total protein crop feed use and the importance of biofuel by-products

Table EQ2.7, derived from Chapter 3, describes the composition of protein feed demand since 1993 in protein content. This combines data on domestically produced and imported sources of protein, and includes meat and bone meal, as well as all vegetable protein ingredients.

Table EQ2.7: Average annual EU-27 demand for vegetable protein feed ingredients plus meat and bone meal in compound feed ('000 tonnes, protein content)

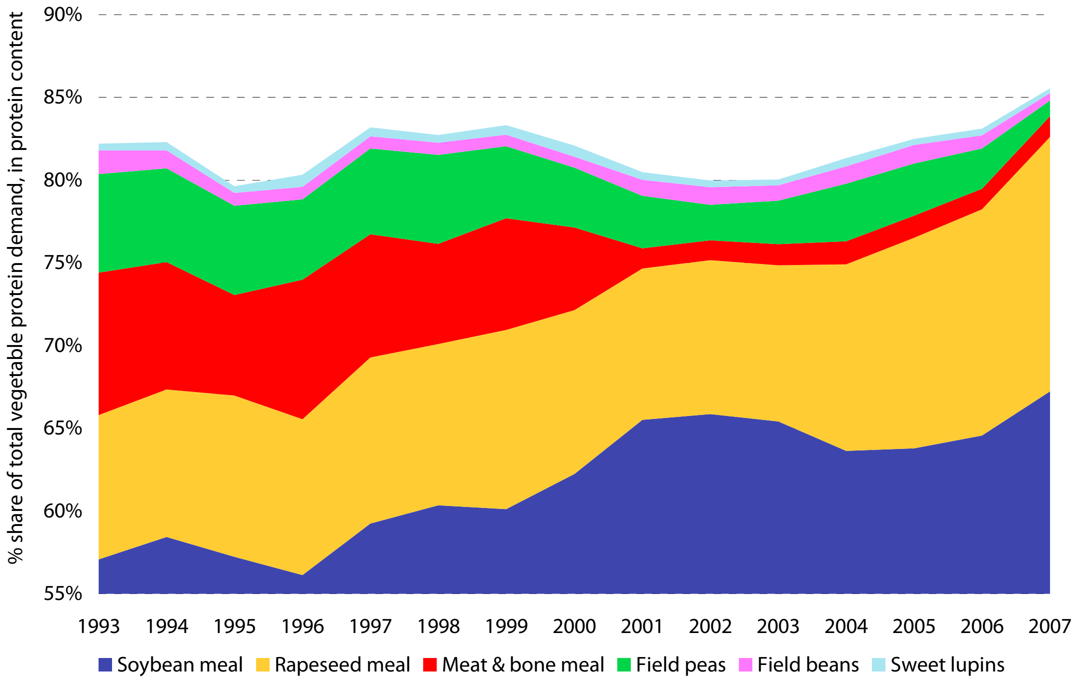
	1993-1999	2000-2003	2004-2007
Soybean meal	11,965	14,320	14,701
Rapeseed meal	1,975	2,088	3,017
Field peas	1,070	635	571
Field beans	181	200	191
Sweet lupins	111	103	88
Dry fodder	833	862	833
Other vegetable protein	4,345	3,896	3,308
Meat and bone meal	1,489	476	298
Combined total	**21,969**	**22,580**	**23,006**

Sources: DG Agri., FEFAC, AC Toepfer, USDA

In 1993-1999, protein crops met 6.2% of the total demand, and meat and bone meal (MBM), which, as noted earlier, was often mixed with protein crops in feed, to compensate for their relatively low protein content, supplied 6.8%. In 2000-2003, in which most feed uses of animal products were banned, the protein crops and MBM shares fell to 4.2% and 2.1%, respectively. In 2004-2007, the protein crop proportion fell further to 3.7% and the MBM share to 1.3%.

Diagram EQ2.1 illustrating demand for each of the three protein crops, as well as meat and bone meal, rapeseed meal and soybean meal, all in protein content and all as a share of total vegetable protein demand in the EU, demonstrates the sharp decline in both the protein crop and the MBM shares of total protein input use in the EU. The gains in market share made by soybean meal (which increased from approximately 55% to over 65% of the total over the past 15 years) and rapeseed meal (from below 9% to over 15%) are evident from the diagram.

Diagram EQ2.1: Demand for leading protein feed ingredients as a share of total EU vegetable protein feed demand, 1993/94-2007/08



Sources: DG Agri., FEFAC, AC Toepfer, USDA

The major beneficiaries from the decline in protein crop and MBM use in feed were rapeseed meal, whose supplies were boosted by rising biodiesel production from rapeseed oil and whose feed volumes rose almost 50% between 2000-2003 and 2004-2008, and soybean meal, nearly all of whose growth occurred between 1993-1999 and 2000-2003.

A possible surprise, in view of the growth in cereal-derived ethanol output worldwide, is the fall in corn gluten feed and DDG imports and demand revealed in Table EQ2.6. FEFAC, in its 2007 Statistical Yearbook noted "*corn gluten feed imported from the USA …. almost disappeared in 2007, due to the zero-tolerance policy for risk-assessed, but not yet EU approved, GMOs*". Similar factors have limited imports of US DDG in recent years.

The evidence from case study interviews and from analysis of the trade data is that:

- The fall in domestic protein crop supplies has not caused particular concern to the feed compounding industry. The sector was more affected by the reduction in the availability of MBM, whose 50-60% protein content was used to counter-balance the relatively low protein content of protein crops.
- Increased rapeseed meal supplies and the greater price competitiveness of feed cereals have made it possible for large compounders to use rapeseed meal and/or mixtures of soybean meal and feed cereals to replace declining local supplies of protein crops.
- Foreign trade often allows EU feed use of protein crops to exceed local output. Sweet lupin users have always relied on imports to meet some of their needs. Field pea users, too, often turn to imports to meet a share of local feed demand, with Canada the main supplier when Canada's exports to Asia are low, as in 2004-2006. Field beans are the sole protein crop whose local feed demand is easily supplied from EU output.
- On-farm feed use has been better maintained than bulk feed applications, since the minimum economic scale of storage and of handling systems that is an issue for industrial feed compounders is not a constraint for individual farmers.

1.4. Quality requirements and the ease of substitution in feed uses

The needs of feed compounders for protein ingredients are determined by the composition of these ingredients in physical characteristics such as crude protein and fibre, amino-acid composition, digestibility (which differs by animal species) and metabolisable energy.

There are some end-uses for which other factors play a role. Organic products are one; non-GMO feed is another. Colour is very important in some end-uses, such as horse and bird feeds. Before turning to a consideration of the role of protein crops as an ingredient for the major feed compounding industries, we consider the organic and non-GMO segments of the market, where it might be felt that protein crops would be well placed to maintain sales.

1.4.1. The significance of organic and non-GMO production

At present, the ability to claim non-GMO status is not a major advantage for protein crops. Domestically processed rapeseed meal and sunflower meal are both non-GM, and they are plentiful and have the added advantage of higher protein content than field peas and beans. An organic claim is more valuable in commercial terms, since organic output is a subset of non-GMO supply, but has additional costs associated with its agricultural production by virtue of its lower yields per hectare and because it has to bear the costs of establishing a special, separate supply chain.

The extra value of organic protein crops to livestock farmers was acknowledged in interviews with producers and their organisations, who observed that protein crops may be used directly in feed, and are grown on a small scale, ensuring that traceability is not an issue. For the main oilseed meals, this is not so straightforward, since crushers process large tonnages of oilseeds daily, and face significant costs when they establish a separate identity-preserved supply chain solely for the crushing of modest volumes of organic oilseeds.

Comprehensive data on the importance of organic production of protein crops are not available for all MS. Two reasons were provided in interviews for this: one is that the high proportion of such crops that are used on-farm has made the collection of data, particularly regarding production volumes, difficult; the other is that the protein crop sector is relatively small in many MS, and so data on organic output are aggregated with data on other crops.

Organic protein crop production as a share of total output varies considerably from MS to MS. In Germany, the organic share is significant. In Lower Saxony, the region selected for the case study, where there is considerable on-farm protein feed use, the share of organic crops in the Land's total protein crop area rose from 38% in 2005 to 62% in 2008, with the highest organic proportions observed for field beans and sweet lupins. Yet, despite the rise in their shares, the areas grown organically under the three protein crops declined (by 38% overall over the three years), but this was less dramatic than the decline of 77% in conventionally farmed areas. It was estimated by local associations that organic output was close to 40% of the national total.

In France[42], the total organic protein crop area (including land still in conversion) in 2002-2003 was 15,641 hectares (3.5% of the total); this fell in 2004-2006 to 11,470 hectares (2.9%), farmed mainly by livestock producers, with only 18% of organic producers classed as COP specialists. The organic shares of total areas in 2003-2006 were 1.0%, 9.2% and 6.9% for field peas, field beans and sweet lupins, respectively. As weed control is a problem in organic crops, field beans were favoured, since they cover the earth better, but organic crops experience a loss of yields, estimated at 10-20% for field beans, 20% for sweet lupins and 25-30% for field peas.

In Spain, evidence provided by the questionnaires suggests that organic farming accounts for around 10% of total protein crop production within the sample of farmers surveyed, but this is much higher than the estimates mentioned in interviews. None of the UK respondents produced organic protein crops; in interviews they suggested that organic output was no more than 1% of the total. As elsewhere, organic crops are farmed mainly on mixed crop-livestock farms, where they are used for on-farm feed to ensure the traceability of feed inputs.

In Hungary, around 20% of the farmers surveyed produce organic protein crops. At a national level, organic protein crop areas and output are not recorded separately from conventionally farmed areas and production. In Poland, after the accession, several support schemes were introduced for organic farming. However, the sector is still very small (out of around 2 million farms, only around 11,000 have "organic" farming certificates) and the production of certified organic protein crops is still modest. None of the farmers surveyed produced organic crops.

1.4.2. Substitution between protein ingredients

In compound feeding, protein crops are just one sub-set of many alternative ingredients that provide protein. Table EQ2.2 highlighted the relatively low protein content of the protein crops. This limits their use in a number of feed applications.

The suitability of these ingredients for different types of animal feed depends on many factors: notably the species, their age, and their specialisation (e.g., egg-layers vs. meat birds). Feed mixtures for poultry start with a high protein content (up to 28-30% protein) for young birds, falling later to feeds with roughly half the protein content. For pigs, too, young animals start with a high protein feed (20-25% protein), and they are finished with a feed with half the protein content. Since the protein content of field peas and field beans is only 21% and 26% respectively, their use is restricted, particularly now that meat and bone meal with a 50-60% protein content cannot be used to boost the overall protein content of a mixture.

A different constraint upon the use of protein crops in compound feeds is their amino-acid composition and nutritional qualities, including digestibility by the animal being fed.

[42] *La filière protéagineuse, quels défis?* Edited by Guéguen & Duc, 2008, Editions Quae,.

For pigs, the biggest single animal species end-user of protein crops, an attraction of field peas is that their net energy value is 20% higher than that of soybean meal, but the balance required between the major amino-acids in the feed restricts field pea use in pig feed to a maximum of 15-20%. The effective limit for mixing field beans into pig feed is typically lower, at 10-15%, because most bean varieties are high in tannins, which limit their digestibility.

In poultry, the second largest species as a consumer of protein crops, field peas range up 25% of feed for meat birds and 20% for layers. Most field bean varieties are again limited by their tannin content. Varieties that are high in glycosides, vicine and convicine are limited to 7% of poultry feed. Lupins are used in limited amounts in poultry feed; 5% is the usual maximum.

For cattle, field peas are not a very attractive feed, as the crop's protein degrades very rapidly in the animal's rumen, reducing its value. Field beans, especially those high in tannins, are appreciated as a feed, particularly for dairy cattle. Sweet lupins may also be mixed at fairly high incorporation rates for dairy cattle.

The flexibility to combine alternative ingredients to achieve, at least cost, a given minimum combination of the range of amino-acids explains why there was negligible evidence from interviews that feed compounders view protein crops as essential feed ingredients, whose decline in supplies in recent years might have created difficulties in their feed compounding.

These findings were confirmed by the questionnaires completed by feed compounders. When asked "In your feed mixing, is it difficult to replace field peas, field beans, and/or sweet lupins with alternative ingredients?", all respondents across the six case study MS answered "No". The only exception, noted in the interviews with feed compounders, was where customers stipulate that their feed must not include genetically modified raw materials, but even in that case, there are alternatives readily available locally, notably rapeseed and sunflower meals.

We conclude that the EU feed sector has found it easy to secure the protein ingredient supplies it needs, in terms of amino-acid and overall protein content, without having to rely upon protein crops. The increase in rapeseed output in response to the CAP energy measures has expanded the availability of rapeseed meal, which has a much higher protein content than field peas and field beans. This is welcomed by feed compounders, since this meal is well placed to meet the changed structure of demand for protein ingredients, as compounders have sought ingredients with a reasonably high protein content to offset the banning of the use of animal protein sources, with a very high protein content, in 2001 as a result of BSE.

2. Effects of the 2003 reform on the geographical distribution of supply

The impacts of the 2003 reform on the geographical distribution of supply are analysed by examining the changes in the location of feed compounders and the changes in the apparent consumption of protein crops by member states.

2.1. Changes in the location of feed compounders

Table EQ2.8 describes the distribution of feed processing plants since 1997 for the EU-15 and since 2004 for the EU-25. Spain, Italy, and UK have the largest number, and in all three the number of plants has declined since 1997. The data from FEFAC for the EU-10 MS[43] extend back only to 2004, which means that the coverage for the EU-25 is only available since then.

[43] Data on plant numbers for Bulgaria and Romania are not included in the FEFAC figures; however, statistics on compound feed output are available, and reveal that Romania produces 2.0% and Bulgaria produces less than 0.5% of the EU-27 total. The estimated Bulgarian output rose by approximately 16% between 2004 and 2008, but Romania's production increased by an estimated 64% in the same four years.

Table EQ2.9 describes the annual average rate of decline in the numbers of plants in the EU-15 since 1997 and in the EU-25 since 2004 and also the average throughput of each plant. The average throughput per plant has risen particularly fast in the EU-10 MS. The number of EU-15 feed mixing plants fell by 3.4% per annum from 1997 to 2003; from 2004, the decline slowed to an annual average rate of 1.9%. The annual decline in the number of plants in the EU-10 in 2004-2007 was 5.3%. Annual throughput per plant rose at an average rate of 4.1% per annum in the EU-15 in 1997-2007 and at an average rate of 2.4% in 2004-2007. For the EU-10, the average growth in throughput in 2004-2007 was 8.1% per annum.

Table EQ2.8: Feed processing plants by number of units by MS, 1997-2007

	1997	2004	2007
Germany	541	396	352
France	410	330	316
Italy	968	700	640
Netherlands	258	136	120
Belgium	80	77	77
UK	615	460	440
Ireland	84	76	70
Denmark	165	79	64
Spain	1,071	922	880
Portugal	70	65	61
Austria	150	70	103
Sweden	23	21	20
Finland	13	12	10
EU-15	***4,448***	***3,344***	***3,153***
Cyprus		47	45
Czech Republic		226	201
Estonia		21	18
Hungary		290	260
Lithuania		19	19
Latvia		19	17
Poland		136	114
Slovakia		369	280
Slovenia		18	17
EU-10		***1,145***	***971***
EU-25		***4,489***	***4,124***

Source: FEFAC Feed and Food Statistical Yearbook, 2007, and CESFAC (Spain)

An important structural change noted in interviews was that increasing rationalisation was associated with a growing geographical concentration away from areas where feed inputs are grown towards locations with good access to the ports through which soybeans (or its meal) are imported. As the scale of feed mixing plants grows, their requirements in terms of storage capacity and the availability of regular supplies of ingredients follow suit. The lower volume of protein crop supplies in recent years has raised the unit costs of handling them. Interviews reveal that this was among the factors causing feed companies to reduce their use of these crops. This is part of the vicious circle, mentioned in interviews by producers, traders and seed companies in many MS, that is being created by a lack of critical mass within the sector.

As the volumes of local supplies of protein crops continued to decline, many activities linked to the sector, ranging from the development of new varieties and agri-chemicals for farmers through to the operation of separate supply chains and storage capacity for protein crops, became less profitable. This was because fixed costs of these services had to be covered on smaller volumes of sales, and this inevitably raised the unit cost of providing these services. As an example, the feed use of protein crops in the 2007/08 marketing year was only one third of the level in 2004/05. If all plants had maintained the capacity of their separate silos for protein crops, the unit fixed costs of operating them would have trebled per tonne of these products.

Table EQ2.9: Annual average changes in the number and annual throughput of EU-15 and EU-25 feed compounding plants, 1997-2007 (% per annum)

	1997-2007	2004-2007
Number of feed mixing plants		
EU-15	-3.4%	-1.9%
EU-10		-5.3%
EU-25		-2.8%
Throughput in tonnes per plant		
EU-15	4.1%	2.4%
EU-10		8.1%
EU-25		3.5%

Source: FEFAC and CESFAC (Spain). National detail is provided in the case study monographs.

2.2. Apparent consumption of protein crops by individual MS

The demand for protein crops by MS is difficult to derive with precision, because the monitoring of intra-EU trade in both protein ingredients and compound feed is not precise.

Table EQ2.10: Average use of protein crops by MS, 2000-2003 to 2004-2007 ('000 tonnes)

	Field peas 2000-2003	Field peas 2004-2007	Field beans 2000-2003	Field beans 2004-2007	Sweet lupins 2000-2003	Sweet lupins 2004-2007	Protein crops 2000-2003	Protein crops 2004-2007	*% change in total*
France	1,076	722	103	123	32	18	1,211	862	*-29%*
Germany	447	323	67	46	108	93	622	462	*-26%*
Spain	474	791	82	83	75	35	631	909	*44%*
UK	241	139	469	486	11	13	721	637	*-12%*
Belgium-Lux	301	280	1	-5	2	1	304	276	*-9%*
Denmark	89	44	2	3	0	0	91	48	*-47%*
Greece	1	6	6	5	0	0	7	11	*61%*
Italy	127	167	235	189	5	7	368	363	*-1%*
Ireland	28	11	0	0	0	0	28	11	*-62%*
Netherlands	189	158	3	3	76	54	268	214	*-20%*
Portugal	3	6	20	22	10	3	34	31	*-9%*
Austria	97	85	8	9	0	1	105	95	*-10%*
Finland	12	9	0	0	0	0	12	9	*-27%*
Sweden	74	55	0	0	0	0	74	55	*-26%*
Poland	25	22	21	20	15	36	61	78	*28%*
Hungary	42	49	2	2	1	0	45	51	*13%*
Cyprus	0	0	0	0	0	0	0	1	*36%*
Czech Rep	42	51	4	5	0	0	46	56	*22%*
Estonia	5	6	0	0	0	0	5	6	*27%*
Latvia	4	2	0	0	0	0	4	2	*-44%*
Lithuania	35	19	0	0	2	5	37	24	*-34%*
Malta	1	0	1	1	0	0	2	1	*-38%*
Slovakia	14	20	1	2	0	1	15	23	*53%*
Slovenia	0	5	0	0	0	0	0	5	*949%*
Bulgaria	7	4	0	0	0	1	8	5	*-32%*
Romania	22	36	0	0	0	0	22	36	*65%*
EU-15	**3,159**	**2,794**	**996**	**964**	**320**	**226**	**4,476**	**3,984**	***-11%***
EU-12	**197**	**215**	**30**	**30**	**18**	**43**	**245**	**288**	***18%***
EU-27	**3,356**	**3,009**	**1,026**	**994**	**338**	**269**	**4,721**	**4,271**	***-10%***

Sources: COMEXT, FAO, DG Agri

In Table EQ2.10 we have derived national demand by MS by adding net imports of each protein crop (combining intra-EU and extra-EU trade) to the production of these crops in the same MS. The data shown are for the periods 2000-2003 and 2004-2007. Detailed annual data are presented in Appendix 1: Protein crop supply and demand balances.

The vast majority of demand for these crops in the EU, though not in export markets, is for feed. The data do not permit any sort of disaggregation between the use of these crops for feed compounding or as on-farm feed. Moreover, in view of the lack of precision in intra-EU trade data, the figures in this table should be treated with caution. Subject to this proviso, we note that there have been a few large changes in apparent protein crop use in individual MS.

In France and Germany, two of the largest users of protein crops, there appear to have been decreases of over 25% in protein crop demand after the 2003 measures. In contrast, demand in Spain, another major user of these products, rose by over 40% in the same period. All three of these MS consumed predominantly field peas, and that was the product in which the large demand changes occurred. The only other MS that consumed more than 100,000 tonnes of protein crops per annum in the period after 2004 were the UK, Belgium, Italy and the Netherlands. Overall, 70.4% of the total EU-27 demand in 2004-2007 was for field peas, 23.3% was for field beans and the remaining 6.3% was for sweet lupins.

3. Effects of the 2003 reform on prices paid by feed compounders

During interviews, many feed compounders stated that it was simple to substitute other protein inputs for protein crops, thanks to the availability of these alternative feeds and the ease with which least cost linear programs enable them to determine the cheapest substitutes. We now consider whether evidence of the pricing of protein crops supports their view that there is strong substitutability between protein crops and other feed ingredients.

Table EQ2.11 compares field pea prices with prices of leading protein ingredients (where all are expressed on a soybean meal equivalent basis). It reveals the field pea prices are high vis-à-vis alternative protein ingredients once their low protein content is taken into account.

With regard to protein crop prices, there are only two MS for which comprehensive wholesale price data for all three products are available over the entire period since the 1993 CAP reform. These are the Netherlands and France, particularly the region of Brittany, which is the main centre of feed use of field peas in France. The Netherlands is a major location for feed compounding. Rotterdam handles large volumes of feed ingredients, many in transit to other MS; therefore its prices are widely used as a reference for trade within the Community.

Table EQ2.11: Price of protein ingredients (€/tonne of soy meal equivalent, 48% protein)

	Soybean Meal	Rapeseed Meal	Sunflower Meal	Palm Kernel Meal	Coconut Meal	DDG	Corn Gluten Meal	Corn Gluten Feed	Field peas
2000/01	224	183	158	187	155	226	241	158	377
2001/02	221	192	173	182	289	222	259	182	383
2002/03	183	151	136	177	222	209	219	160	352
2003/04	191	167	137	190	249	206	201	172	399
2004/05	202	154	141	200	191	149	233	179	309
2005/06	190	135	134	179	178	177	221	160	326
2006/07	169	129	131	194	246	210	200	176	401
2007/08	218	181	192	363	290	231	252	204	594
2008/09	325	309	314	393	359	182	354	289	469

Source: USDA, TNS, Public Ledger, Oil World, *La Dépêche*, UNIP, In the analysis that follows we focus only on field peas. It is the most important protein crop used in feed, and is the only one for which long series of monthly price data for feed inputs are available (in both France and the Netherlands). The discussion in EQ1 revealed that field bean and sweet lupin quotations for feed grade products are intermittent and seasonal.

According to *La filière protéagineuse, quels défis ?*[44]

> "Le prix du pois s'établit en fonction du prix du tourteau de soja et des céréales.»

To assess the validity of this statement, we have analysed field pea prices as a function of the local prices of feed wheat and soybean meal. The hypothesis that we test is that there is a stable relationship (expressed as a linear function) between the prices of protein crops and those of other feed inputs. This is because feed compounders' least cost feed formulations are linear combinations of individual feed ingredients.

Hence, if protein crops have close substitutes among other feed inputs, it would be expected that protein crop prices would be highly correlated with a linear combination of the prices of other ingredients, including some that are higher and some lower in their protein content than protein crops, so that a weighted average combination of these alternative ingredients could be prepared that would have a similar protein content to the protein crops for which they would be substitutes.

The results of this analysis are depicted in Diagrams EQ2.2 and EQ2.3. The former diagram contrasts field pea prices in Brittany since 1993/94 with estimates derived from econometric analysis of the field pea price as a linear function of local feed wheat and soybean meal prices. The latter diagram applies the same methodology to Dutch prices, using calendar year data since 1993. The data underlying the two relationships are summarised in Tables EQ2.12 and EQ2.13.

The regression analysis for Breton prices was first undertaken without constraints on the value of the intercept in the equation, but the coefficient of the intercept was not statistically significant at the 95% level. Therefore, the equation used to construct the diagram constrains the intercept to be zero.

The results of the linear regression analysis (presented beneath the diagram) indicate that field pea price may be expressed as a combination of the feed wheat price and of the soybean meal price. The feed wheat price has a coefficient of 65% in the resulting equation, while the soybean meal price has a coefficient of 32%.

We tested for any non-stationary behaviour in the error term using standard augmented Dickey-Fuller tests, which rejected the hypothesis of unit roots. In other words, the tests suggest a stationary relationship between the field pea price and the other price series.

The high value of the adjusted R^2 (92.8%) reveals that most of the variation in the field pea price is explained by the regression equation.

The high values of the t-stat for the coefficients of both feed wheat and soybean meal prices indicate that these two coefficients are statistically significant at a 95% confidence level.

The very low F significance indicates that both variables (the feed wheat price and the soybean meal price) have some effect on the field pea price at a 95% confidence level.

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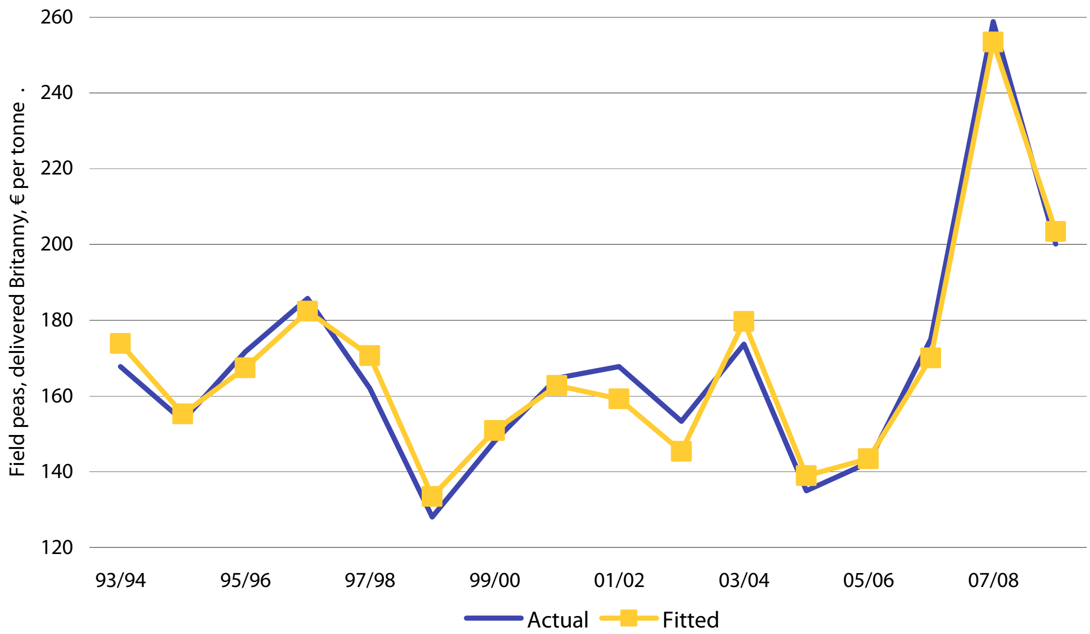
[44] Page 24, *op. cit*.

Diagram EQ2.2: Analysis of marketing year field pea prices as a function of feed wheat and soybean meal prices, Bretagne (Centre), France



Source: UNIP

Field pea price = 0.65 Feed wheat price + 0.32 Soybean meal price

(t-value 10.6) *(t-value 8.6)*

Adjusted $R^2 = 0.928$ Significance $F = 1.3039 \times 10^{(-20)}$

Table EQ2.12: Field pea, feed wheat and soybean meal prices, Brittany, 1993/94-2008/09 (€ per tonne)

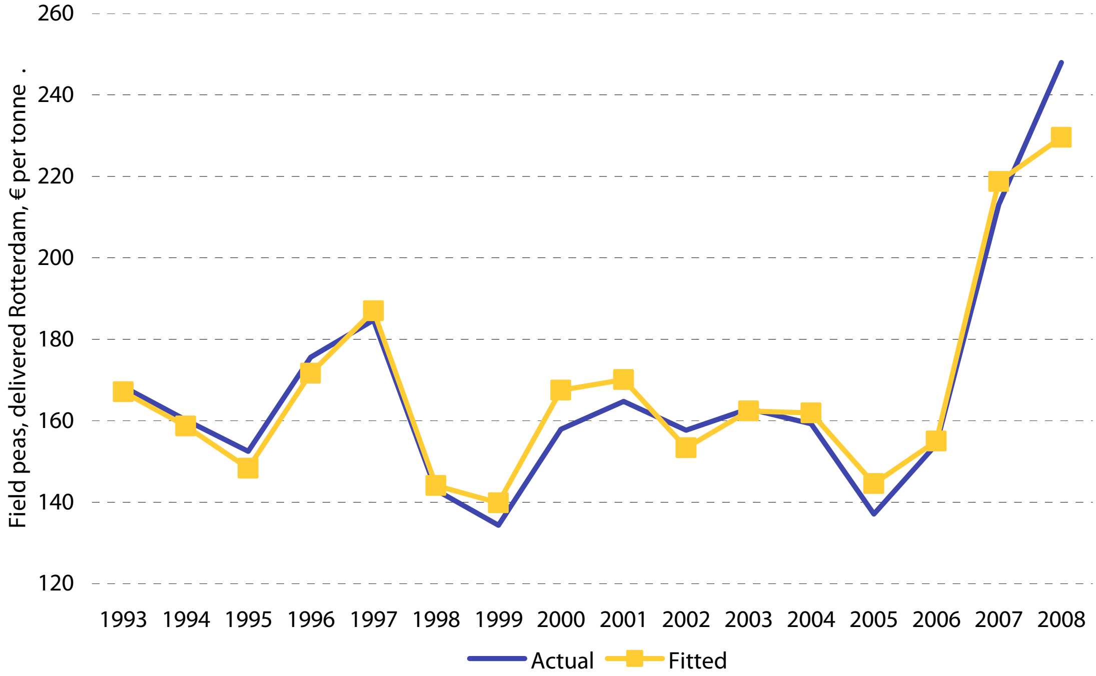
	Field peas	Feed wheat	Soybean meal
1993/94	167.8	157.3	221.7
1994/95	153.5	149.8	179.3
1995/96	171.6	154.4	207.6
1996/97	185.7	144.9	272.8
1997/98	162.0	135.2	255.7
1998/99	128.0	122.9	165.8
1999/00	148.0	129.9	205.4
2000/2001	164.7	125.3	251.4
2001/02	167.7	126.7	237.8
2002/03	153.3	114.9	218.6
2003/04	173.7	150.4	253.4
2004/05	135.0	111.7	205.1
2005/06	142.4	117.9	206.6
2006/07	175.0	154.6	215.3
2007/08	258.9	228.9	323.8
2008/09	200.1	159.3	308.7

Source: UNIP

The coefficients derived for the soybean meal and feed wheat terms are very close to the ratios observed when French farmers prepare their own on-farm feed mixtures. They stated in interviews that they typically mix one part of soybean meal to two parts of feed wheat as direct replacements for field peas in feed. This analysis of the French data suggests strongly that the wholesale market appears to value field peas in Brittany in almost exactly this ratio.

We conclude that the prices paid in the Breton wholesale market confirm that compounders value field peas as a simple 2:1 weighted average of feed wheat and soybean meal prices. This suggests that it was relatively easy for local feed companies to adapt to reductions in field pea supplies by substituting them with other feed ingredients.

Diagram EQ2.3: Analysis of calendar year field pea prices as a function of feed wheat and soybean meal prices, Rotterdam, Netherlands, 1993-2008



Source: LEI, Wageningen

Field pea price = 0.58 Feed wheat price + 0.42 Soybean meal price

(t-value 9.0) *(t-value 11.0)*

Adjusted $R^2 = 0.927$ Significance $F = 1.8367 \times 10^{(-19)}$

The corresponding analysis of Dutch wholesale prices differs in one important respect; the local soybean meal price that is used in the analysis is consistently slightly cheaper than that in Brittany. Dutch prices are very close to Breton ones for both field peas and feed wheat.

The results of the regression analysis of the Dutch data indicate that field pea price may be expressed as a combination of the feed wheat price and of the soybean meal price, with a coefficient of 58% for the feed wheat price term and one of 42% for the soybean meal price.

We tested for non-stationary behaviour in the error term using augmented Dickey-Fuller tests, mentioned above, and these rejected the hypothesis of unit roots. The tests therefore suggest a stationary relationship between the field pea price and the other price series.

As in the Breton analysis, the high value of the adjusted R^2 (92.7%) reveals that most of the variation in the Rotterdam field pea price is explained by the linear regression equation.

The high values of the t-stat for the coefficients of both feed wheat price and soybean meal price indicate that these two coefficients are statistically significant at a 95% confidence level.

The very low F significance indicates that both independent variables (the feed wheat and soybean meal prices) have an effect on the field pea price at a 95% confidence level.

The main difference between the French and Dutch results is the higher coefficient for the soybean meal term in the latter analysis (the value was 0.42 in the Netherlands, as against 0.32 in Brittany), and a lower coefficient for its feed wheat term (0.58, as against 0.65).

This would be a logical cost-minimising response to the relatively lower Dutch cost of soybean meal in feed formulation. The Dutch analysis, like that of French prices, supports the view of feed compounders that protein crops are relatively easy to replace.

As discussed in EQ1, the absence of full time series and consistent data makes analysis of field bean and sweet lupin wholesale prices more difficult. As with field peas, France is traditionally viewed as the EU reference point for regular prices for field beans for feed, but the weekly prices published by the French magazine *La Dépêche* have many gaps in the series. For sweet lupins the problem of comprehensive series of price data is much worse.

Analysis for the limited number of weeks in which quotations exist for both sweet lupins and field peas for feed uses in the Centre region of France after 2000 indicates that the average sweet lupin premium over field peas was 23.0%. For feed uses of field beans, the Marne/Ardennes premium over field peas for feed in the same weeks in the same region averaged 4.7%. The sweet lupin and field bean price premia over field peas reflect their higher protein contents than field peas.

Table EQ2.13: Field pea, wheat and soybean meal prices in Rotterdam, 1993-2008
(€ per tonne)

	Field peas	Feed wheat	Soybean meal
1993	168.4	139.0	206.0
1994	160.2	140.5	183.8
1995	152.5	137.5	163.4
1996	175.6	131.0	227.8
1997	184.7	118.5	281.4
1998	143.0	116.5	182.1
1999	134.3	119.5	167.9
2000	157.9	119.5	233.7
2001	164.7	118.0	241.9
2002	157.7	106.0	218.6
2003	163.0	124.0	215.4
2004	159.2	116.5	224.5
2005	137.1	102.0	203.2
2006	154.2	127.0	193.8
2007	213.1	200.0	244.8
2008	248.0	169.6	312.4

Source: LEI

3.1. Prices of protein crops in food uses

By virtue of their large share of world trade in field peas, Canadian exports are a major influence upon the traded prices of field peas in food uses. The relationship that seems best to describe the behaviour of yellow field peas, which are the grade most widely used as a food, is the one suggested by the discussion of protein crop quality and Canadian export prices in EQ1. This is that the share of yellow field pea exports to South Asia in total Canadian field pea exports is a major determinant of the yellow pea premium over the price of field peas for feed uses.

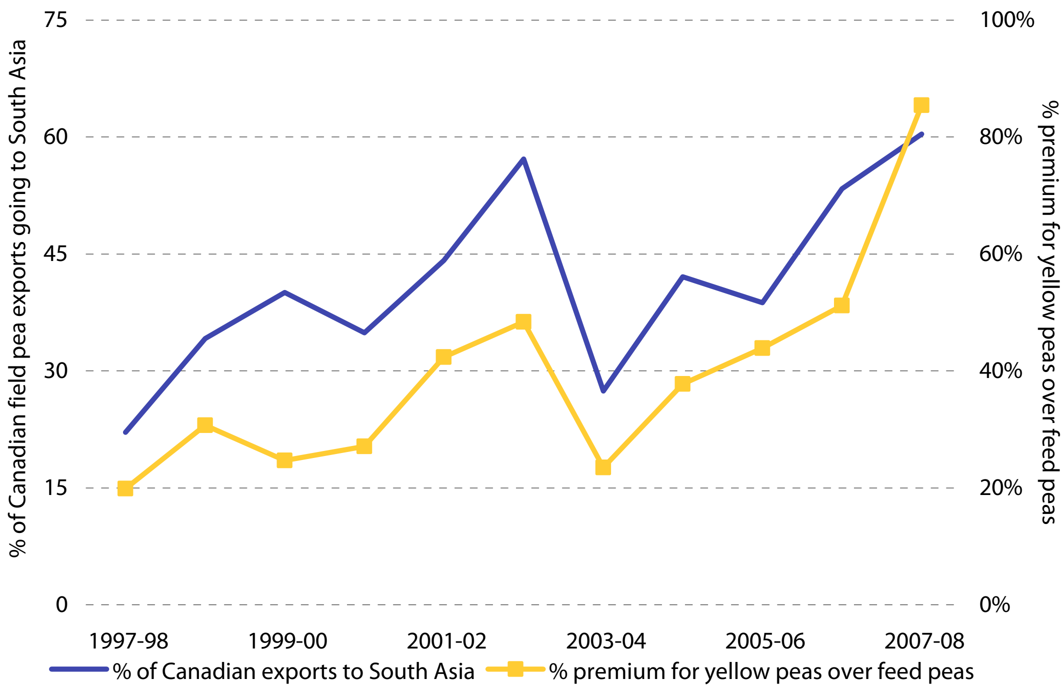
Diagram EQ2. 4 plots the two series against one another from 1997/98 to 2007/08, applying data from Table EQ2.14. We prepared a linear regression of the food grade yellow field pea premium on the South Asian share of Canadian field pea exports. Since it is to be expected that if there were no demand for such peas from South Asia, there would be no premium for peas destined for food uses, we constrained the intercept to be zero. The result is summarised below the diagram.

Table EQ2.14: Share of Canadian field pea exports to South Asia and % premium for yellow field peas over feed grade field pea prices in Saskatchewan, 1997/98-2008/09

	% of Canadian Exports to S Asia	% Premium for Yellow over Feed Peas
1997-98	22.1%	19.9%
1998-99	34.1%	30.7%
1999-00	40.1%	24.7%
2000-01	34.9%	27.1%
2001-02	44.2%	42.4%
2002-03	57.2%	48.4%
2003-04	27.4%	23.5%
2004-05	42.1%	37.8%
2005-06	38.8%	43.9%
2006-07	53.4%	51.2%
2007-08	60.4%	85.4%
2008-09	44.5%	39.4%

Source: Saskatchewan Department of Agriculture.
Note: The 2008-09 data cover only the first half of the marketing year.

Diagram EQ2.4: The % premium for yellow field peas over feed peas in Canadian exports vs. the South Asian % share of Canadian exports, 1997/98-2007/08



Source: Saskatchewan Department of Agriculture

The % premium for food grade yellow field peas over feed grade field peas

= 0.0098 x the % share of exports to South Asia in Canadian field pea exports
(t-value 13.44)

The adjusted $R^2 = 0.847$ Significance $F = 2.9160\text{x}10^{(-7)}$

This means that if South Asian sales account for 60% of Canadian exports, the premium over feed prices for field peas would be expected to be approximately 59% (being 0.0098 x 60).

The t-stat of 13.44 for the coefficient of 0.0098 indicates that this is statistically significant at a 95% confidence level. The value of the adjusted R^2 means that the majority of the variation in the % premium for food grade yellow field peas over feed grade field peas is explained by the % share of exports to South Asia in Canadian field pea exports. The significance F value implies that the % share of exports to S. Asia in Canadian field pea exports has a statistically significant effect on the % premium for food grade yellow field peas over feed grade field peas at a 95% confidence level.

4. The importance of critical mass in a viable sector

One theme that arose repeatedly in discussions with producers, traders, feed compounders, exporters, seed companies, agri-chemical companies, industry associations and government officials was the vicious circle whereby the decline in the scale of the protein crop sector was feeding upon itself and infecting many segments of the industry.

The lack of critical mass extends throughout the supply chain. Local traders, exporters and compounders remarked upon the difficulties presented by the fixed costs of maintaining separate storage bins for protein crops and the higher costs of collecting a reasonable quantity from over longer distances, as the volumes available decline.

In Germany, a major farm association stated that 180,000–200,000 hectares is the threshold needed for sustainable protein crop market development in Germany; this is 50% higher than recent areas. Three German seed companies are developing seeds, yet fewer than 50,000 hectares (the area considered appropriate for just one firm) are planted with certified seeds. All three large trading companies interviewed in the same MS stated that low quantities, a low protein content, high unit transaction costs in a segmented market and profitable alternatives for mixing oilseed meals in feed meant that they are no longer active in protein crop trading.

In France and the UK, too, the loss of critical mass was frequently mentioned as a major problem in the sector, deterring investment in new variety development, as well as in research into new agri-chemicals, but most importantly in lessened willingness to continue to maintain a separate *filière* for the storage and distribution of protein crops. In France, cooperatives commented upon the growing conflict between continuing to market protein crops supplied by their members and the increasing cost of marketing these crops.

Faced with a choice between using declining volumes of protein crops, which require their own separate supply chains and storage facilities, and large quantities of readily available oilseed meals (both locally produced and imported), with a higher protein content, many of the processors interviewed remarked that, outside special niches in the feed sector, such as pet food, their commitment to the continued use of protein crops was declining, and these crops were in danger of losing the critical mass needed to maintain the viability of the sector.

On-farm feed is one of the few applications in which critical mass in the supply chain is of no concern; but mixed crop-livestock producers are adversely affected, in common with other protein crop producers, by the limited investments being made in seed and chemical R&D.

5. Conclusions

The questions posed at the start of EQ2 are repeated below:

How have the CAP measures influenced supplies to the compound feed industry, with regard to crop (beans, peas, sweet lupins); quantity; prices; geographical distribution?

To what extent have these supplies corresponded to the plant protein needs of the compound feed industry and influenced substitution with other plant protein sources?

Effects of external developments. Events outside the protein crop sector have played a major role in the decline in the use of these crops by the feed sector. The ban on meat and bone meal in most feed uses in 2001 removed a vital complement, with a high protein content, for field peas and beans, whose protein contents are low in comparison with alternative protein ingredients. Another extremely important factor was the large increase in the availability of rapeseed meal, with a much higher protein content than field peas and field beans.

Effects of the 2003 reform on the changes in quantity and type of protein crops purchased by the feed compounding industry. Chapter 4 described the decline in the domestic supply of protein crops after 2004. It concluded that the impact of the 2003 measures on this decline was insignificant. The feed compounding industry has adapted, without undue difficulty, to this decline by incorporating much larger tonnages of rapeseed meal into their formulations and increasing their use of soybean meal, which is imported duty-free.

Effects of the 2003 reform on the geographical distribution of supply. Feed compounding plants have been moving from areas of crop production to areas near ports, where imported supplies, notably of soybean meal, can easily be obtained, and where rapeseed meal is often readily available from nearby rapeseed processing. This was part of a big restructuring process which started in the 1990s.

The 2003 measures in the protein crop sector had no effect on this process. In terms of shifts in the geographical distribution of apparent protein crop demand for feed uses, our analysis reveals that this has tended to follow production trends by MS, and, as noted above, the 2003 measures in the protein crop sector played an insignificant role in this production trend.

Effects of the 2003 reform on the purchase prices paid by the feed compounding industry. Analysis of French and Dutch field pea prices reveals that the prices paid in feed uses may be characterised as being determined as a simple weighted average of soybean meal and feed wheat prices. This findings support the views of compounders that protein crops are easily substituted in formulations. We conclude that the prices paid for these crops were not affected by the 2003 measures in the protein crop sector. In food uses, the premium paid for yellow peas over field peas in feed is determined by South Asian import demand for yellow peas, and this demand is completely unaffected by the 2003 reform.

Effects of the 2003 reform on meeting the protein ingredient needs of compounders. The reform played an insignificant role in explaining the decline in protein crop supplies to the feed sector. Other external factors, mentioned above, notably the ban on the use of meat and bone meal and the greater availability of rapeseed meal and ease of access to soybean meal from imported sources, reduced the demand for protein crops from the compound feed industry and made it easy for the industry to substitute protein crops in their mixtures with ingredients with a higher protein content.

Chapter 6: Answers to Theme 3 Questions: Competitiveness of Protein Crops

Evaluation Question 3: Competitiveness of the protein crops

To what extent have the CAP measures applicable to the protein crop sector contributed to fostering the competitiveness and promoted the market orientation of protein crop production?

The relative competitiveness of protein crop production vs. alternatives will be analysed before 2004; after 2004; and with full decoupling, including associated production responses.

In view of the importance of crop profitability and gross margins in the analysis in this chapter, we start the detailed discussion in the chapter with a full explanation of the methodology employed to determine producers' incomes.

A particular issue of special relevance to this analysis is the assessment of the externalities associated with protein crop production, which reduce the costs and increase the productivity of the crops that follow protein crops in farm rotations.

Changes in protein crops' competitiveness from a producer's perspective are illustrated in the discussion by changes in planted areas and by changes in protein crops' profitability vis-à-vis other COP crops. The profitability of protein crops is evaluated using the analysis of gross margins, but consideration is also given to the risk associated with protein crop production.

The answer to EQ3 continues with a comparison of the gross margins and incomes of protein crops and other cereal, oilseed and protein (COP) crops before the 2003 protein crop reforms (up to and including 2003), after 2004, and also in the event of full decoupling, the counterfactual case. An analysis of protein crop production in the same three sets of circumstances, i.e., before 2004, from 2004 and with full decoupling is also presented.

Changes in the competitiveness of protein crops from the point of view of end-users are also examined, drawing on the analysis presented in EQ2. The market orientation of the protein crop sector is then assessed, comparing local market prices with their world market counterparts.

Finally, we examine the extent to which the competitiveness of the protein crop sector as a whole has been affected by developments in vital support activities, such as research into improved seed varieties and into agri-chemicals to combat plant diseases.

1. Indicators and evaluation tools:

The judgement criteria, indicators and data sources are summarised as follows.

Table EQ3.1: Judgement criteria, indicators and data sources on competitiveness

Judgement Criteria	Indicators	Data Sources
Changes in the level and volatility of gross margins on protein vs. those on other COP crops	Time series of gross margins from MS selected for case studies Coefficient of variation of gross margins of protein crops and other COP crops	National and regional institutions Case study interviews Producer questionnaires
The importance of benefits from nitrogen-fixing in rotations	Gross margins computed over the full cycle of alternative rotations vs. gross margins without allowance for rotational benefits	National and regional sources Questionnaires and interviews *La filière protéagineuse, quels defis?* Edited by Guéguen & Duc, 2008 *Grain legumes and the environment:* AEP, 2004 *International workshop on faba bean breeding and agronomy*, Cordoba, 2006 *Integrating grain legume biology for sustainable agriculture*, 2007

Estimates of gross margins before 2004, after 2004 and with full decoupling	Computed gross margins for protein crops and the other main COP crops in the case study MS under the three assumptions	National and regional sources Producer questionnaires and interviews
Estimates of protein crop output before 2004, after 2004 and with full decoupling	Application of a simple adaptive model to determine the supply response as relative gross margins change between protein crops and alternative COP crops	National and regional sources
Appropriateness of protein crops for end-users, in terms of quality, quantity and competitiveness with substitute ingredients,	Statements by processors regarding the suitability of local supplies and the availability of alternative ingredients	Processor questionnaires
Market orientation of protein crops	Domestic prices vs. world market prices of protein crops	Stat Canada; La Dépêche, UNIP, LEI, Comext
Investment in the development of new varieties and the attainment of higher yields	The amount of research being undertaken by seed companies on improved varieties Trend in protein crop yields vs. those for alternative COP crops	Interviews with seed companies Research institutions in Canada Eurostat FAO DG Agri

2. Methodology to determine gross margins and producer incomes

The methodology applied to analyse producers' gross margins and incomes is reviewed here. Competitiveness is interpreted so as to reflect the externalities, in the form of rotational benefits that protein crops provide in relation to other COP crops (in the form of nitrogen fixation that reduces input costs for the following crop and the yield increases that protein crops generate in the crop planted on the same land in the next crop year).

2. 1. Definitions of the terms used in the analysis

In the subsequent analyses in this report, we employ the terms "gross margin", "income" and "rotational benefits". We define these terms as follows:

***<u>Gross margin per hectare at market prices</u>* = *<u>Revenues from sales at market prices</u>* – *<u>direct costs of production</u>*, all expressed per hectare,** where

- <u>Revenues from sales</u> = <u>The producer price</u> per tonne x <u>yield</u> per hectare.
- <u>Direct costs of production</u> are <u>specific costs</u>, using the definition employed by FADN, and combine the costs of seeds, fertilisers and chemicals per hectare[45].

***<u>Full gross margin per hectare</u>* = (*<u>Gross margin at market prices</u>* + *<u>Coupled aids) per hectare</u>*.**

- <u>Coupled aids per hectare</u> are taken from the FADN database, as explained below.

<u>Income per hectare</u>* = *<u>Full gross margin</u>* per hectare + *<u>rotational benefits</u>

- <u>The rotational benefits</u> included in this calculation have two elements, higher yields and reduced nitrogen requirements in the following crop.

[45] Direct costs were derived directly in this manner for four of the five case study regions whose costs are analysed over time. The sole exception was Castilla-La Mancha, where the data included depreciation in its cost figures. To make its direct costs consistent with the costs for other regions, an estimate of annual depreciation costs was subtracted from the reported cost figure. The depreciation estimate has been obtained from FADN sample data for protein crop producers among COP specialists in the Centro region.

Full income per hectare* = *Income per hectare* + *decoupled aids.

- Decoupled aids per hectare are taken from the FADN database, as explained below.

2.1.1. Determining coupled and decoupled aids for producers of protein and other crops

The methodology employed to estimate coupled and decoupled aids paid to protein crop producers is as follows. First, for the four EU-15 case study MS, we have extracted from the FADN sample of total COP specialists all those holdings that grow protein crops. The criterion that we used to extract this sub-sample was that the area under protein crops should be > 0.

For the case study regions for which we have cost and revenue data (Seine Maritime, Eure et Loir, East Anglia, Niedersachsen and Castilla-La Mancha), we extracted information on the total aid paid under the SPS (M670CP in the FADN database) to these producers. This is the total amount of decoupled aid disbursed under the SPS across all protein crop producing farms by region, where this aid is paid for the entire holding, not merely on the protein crop areas. We also extracted data on the total area (M670AA in the FADN database) on which decoupled aid was paid on all the COP specialist farms growing protein crops; again, this was for the entire holding, and not merely the protein crop area on the holding.

The decoupled aid per hectare paid to protein crop farmers was derived by dividing the total decoupled aid paid on these farms in each region by the total area on which the decoupled aid was paid. The relatively large number of protein crop farms per region ensures that the aid per hectare is a fair indication of decoupled aids paid to typical protein crop producers in each region.

The decoupled aid per hectare of alternative COP crops was assumed to be identical to that paid per hectare of protein crops for each region, since the aid was not coupled.

To determine coupled aids paid per hectare of protein crops, the total coupled aids paid on protein crop areas within the same sample of protein crop producers were divided by the total protein crop area within the sample. Coupled aids per hectare of each alternative COP crop were derived by dividing the total coupled payments on the areas under each alternative (non-protein) crops in the same sample of protein crop producers by the total areas under each of these alternative COP crops to obtain an estimate of their coupled aids per hectare.

Note: For French *département*s, disaggregated data are not available in the FADN sample, so we used data for Haute Normandie and Centre as proxies for Seine Maritime and Eure et Loir, respectively. The number of protein crop farms in the regions analysed by FADN is: Eure et Loir, 193; Seine Maritime, 21; East Anglia, 36; Niedersachsen, 66; and Castilla-La Mancha, 150

To illustrate this methodology, we take the example of East Anglia. In 2006, the total coupled protein crop payments to protein crop producers among the COP specialists in the FADN database were €63,843, and this sum was paid on a total protein crop area of 1,245 hectares. This implied an average coupled payment of just under €50 per hectare of protein crops.

To determine decoupled payments per hectare of protein crops, and also per hectare of other COP crops, in the same year, we took the total decoupled payments made to those farmers who grew protein crops and were also COP specialists. Their total decoupled payments in 2006 amounted to €3,703,114. This sum was paid on an area (which contained protein crops on a small proportion of the total eligible area) of 12,202 hectares. Accordingly, the average decoupled SPS payment per hectare of protein crops, which was assumed to be equal to the decoupled payment per hectare of other COP crops, was just under €310 per hectare.

Decoupled aid per hectare in 2007 is assumed to be the same as that of 2006 because the FADN data for 2007 were not available at the time this report was prepared.

2. 2. Data used in the analysis

Data used in this section are based on fieldwork for the six case study MS, whose monographs present detailed analysis of local direct costs and revenues. Data on protein crop arable aids and special aids were extracted from the FADN database. Gross margin and income data cannot be obtained comprehensively across all years since 2000 for all six case studies.

No such data exist for Hungary. For Poland, data are available only for one year. Hence, the time series analysis presented below applies to only five regions in four MS, with field pea data for all five regions, and field bean data for two regions. Sweet lupin cost and gross margin data are available only for Poland. The data coverage for protein crops analysed in the case study monographs is summarised in Table EQ3.2.

Table EQ3.2: Coverage of gross margin data for protein crops

Member State	Region	Crop	Years
Spain	Castilla-La Mancha	Field peas	2000-2004, 2006
UK	East Anglia	Field peas	2000-2006
		Field beans	2000-2006
France	Eure et Loir	Field peas	2000-2008
	Seine Maritime	Field peas	2003-2007
Germany	Niedersachsen	Field peas	2000-2007
		Field beans	2000-2007
Poland	National	Field beans	2005
		Sweet lupins	2005

The absence of FADN and national margin data for Hungary and Poland prior to 2004 has restricted the analysis to the five EU-15 regions included in the case study data. In the analysis that follows, we compare data for three years before the 2003 measures were applied (2001-2003) with periods after the reform. For Seine Maritime, we only have data for 2003 in the period before the reform; therefore, "2001-2003" estimates presented below relate solely to 2003 for that region. For Castilla-La Mancha, data are not available for 2005.

Cost and revenue data in the analysis are derived from the local databases used in the case studies. They are based on farm surveys, dividing direct costs into seed, fertiliser and chemicals. Market revenues are derived from data obtained from the same holdings on producer prices and crop yields. This should ensure consistency across the different case studies that are analysed, and thus provide a reliable basis for drawing conclusions.

The institutions that collected the data used in the analysis undertake the task as part of long-standing surveys of farm costs and incomes for national and regional government agencies. The overall number of holdings surveyed is typically large (in hundreds) and is stratified so as to be representative, but protein crop producers are only a subset of the total. However, we believe that the samples of protein crop producers are larger than the numbers mentioned above as forming the basis of the FADN database. For example, the UK sample of protein crop producers that were used to determine UK protein crop margins and incomes was 75 field pea and 201 field bean producers in 2005/06, and 59 and 185, respectively, in 2006/07. (This compares with a figure of only 36 protein crop producers in the FADN database.)

The data are all expressed per hectare. From the perspective of the holding, changes in the overall income of the farm reflects changes in areas, as well as changes in the returns per hectare, but information is not available for these five case study regions about the changes in the UAA or in the areas planted to protein crops of the holdings included in the surveys.

2.3. Rotational benefits

The benefits for the crops following protein crops in a rotation are an important externality from protein crop production. These benefits were estimated from three sources: one was French field research by UNIP, quantifying the average yield increases for a common wheat crop planted immediately after field peas in the rotation, and which estimated the nitrogen saving for the same following crop. The second source was Centres d'Economie Rurale, Numbers 28 and 10, also in France[46], and the third was a paper by Unkovich and McNeill[47].

The percentage yield increase each year in the following wheat crop in each case study is assumed to be the same as that derived by UNIP from its field research (these yield increases averaged just under 10% in 2001-2008). However, it is important to note that the net benefit is less than this, since the main alternative rotation crop, rapeseed, also raises yields in the following common wheat crop. The CER data from 15 years of research imply that, in a rotation, rapeseed generates 72% of the yield increase that is obtained following field peas.

The nitrogen saving from field peas is estimated to be 50 kgs/ha. of usable nitrogen. Unkovich and McNeill calculate that the net usable nitrogen saving from sweet lupins is similar to that from field peas, but that the net saving from field beans was only 60% of that figure, since a great deal of nitrogen was captured in the crop itself. The nitrogen saving, i.e., 50 kgs/hectare for field peas and 30 kgs/hectare (60% of 50) for field beans, is valued at the producer's purchasing price of urea (adapted to reflect the 47% nitrogen content of urea) each year.

2.3.1. Two alternative methodologies to quantify the rotational benefits

The impact of these rotational benefits is quantified under two alternative methodologies.

In the first methodology, two full standard rotation cycles are compared. In one, it is assumed that there is a six year cycle in which, in the first two years, common wheat is planted; this is followed by one year of protein crops; this is then followed by a further two years of common wheat; and the final year in the rotation is one year of oilseeds; after this the full cycle starts again. This is compared with a rotation in which two years of common wheat are followed by one of oilseeds, and this three year cycle is then repeated in the same pattern. Thus, the only difference between the two rotation cycles over a six year period arises in the sixth year, when the first cycle includes protein crops, whereas the second cycle includes oilseeds.

With this approach, where the incomes are compared from two alternative rotation cycles, the externalities for protein crops from rotations are received only one year in six. Therefore, the rotational benefits from protein crops are divided by six, to average them over the full cycle.

In the second methodology, it is assumed that producers quantify the externality for a following common wheat crop from planting protein crops and compare the income earned on the protein crop (including this benefit), with the weighted average income (using planted areas as weights) of the alternative COP crops (this is referred to in the text as "Other COP crops"), taking account of the rotational benefits from planting oilseed crops as a break crop.

This latter methodology is intended to represent the typical alternative open to a producer who adopts a more opportunistic approach to protein crop farming decisions. The crops included in the weighted average "other COP crop" comparisons in this second approach are common wheat, barley and rapeseed for Seine Maritime, Eure et Loir and East Anglia. For

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[46] The CER sources are cited by Anne Schneider, *The dynamics controlling the grain legume sector,* COPA-COGECA, Brussels, March 2008,

[47] *Nitrogen fixation***,** M. Unkovich and A. McNeill**,** Western Australia Department of Agriculture and Food Crop Updates, 1998

Castilla-La Mancha they are common wheat, barley, oats, sunflower and bitter vetch, and for Niedersachsen they are common wheat, barley, maize and rapeseed.

The rotational benefits from oilseeds as a break crop are assumed to apply solely in proportion to the oilseed share of other COP crop areas. This means that, if oilseed crops occupy 20% of the "other COP crop" area, the rotational benefits per hectare of other COP crops will be assumed to be 20% of the rotational benefit from one hectare of oilseeds.

With this second methodology, the assumption is made that producers are not constrained by agronomic considerations in their protein crop area, and that the choice is between planting protein crops with the full rotational benefits attributed to them in the following wheat crop, or planting a weighted average mixture of other COP crops, with the rotational benefits from other COP crops associated solely with the percentage of their area that is under oilseeds.

2.3.2. Application of the first methodology

The results of applying the first methodology are built up in the next eight tables, starting with Table EQ3.3, which summarises the direct production costs estimated for the five case study regions from 2001 to 2007 for field peas, field beans, common wheat, rapeseed and sunflower.

As explained earlier, no data were available for field peas in Castilla-La Mancha in 2005; therefore the 2005 entries are left blank for that region. For both Castilla-La Mancha and East Anglia, the 2007 figures are estimates prepared assuming that input costs changed by the same percentages as those observed in Eure et Loir.

Table EQ3.3: Direct costs of production of COP crops (€ per hectare)

		2001	2002	2003	2004	2005	2006	2007
Field peas	Seine Maritime			405	428	423	435	478
	Eure et Loir	286	284	272	271	255	262	314
	Castilla-La Mancha	235	242	258	324		255	*305*
	Niedersachsen	339	286	313	324	295	300	349
	East Anglia	295	319	309	311	294	311	*373*
Field beans	Niedersachsen	297	252	289	324	299	308	340
	East Anglia	208	214	196	206	195	202	*242*
Common wheat	Seine Maritime			348	376	377	360	399
	Eure et Loir	367	322	294	338	345	339	365
	Castilla-La Mancha	269	259	282	308		307	*330*
	Niedersachsen	546	539	572	602	562	566	637
	East Anglia	419	405	376	389	397	412	*444*
Rapeseed	Seine Maritime			337	391	381	410	403
	Eure et Loir	352	320	328	353	368	355	358
	Niedersachsen	529	531	574	626	596	580	589
	East Anglia	367	369	336	349	372	393	*396*
Sunflower	Castilla-La Mancha	140	164	171	176		180	*181*

Sources: Case study monographs
Note: UK and Spainish 2007 input costs are estimated assuming input prices rose at the same rate as in Eure et Loir. *Values in italics are estimates,*

Table EQ3.4 draws upon FADN data for each production region for coupled aids per hectare paid from 2001 to 2006 for field peas, field beans, common wheat, rapeseed and sunflower. It is assumed that the coupled payments per hectare in 2007 are the same as those reported in 2006. It will be observed that the retention of 25% of the arable aids per hectare as coupled payments in both France and Spain from 2006 is reflected in the data in this table. For both Germany and the UK, coupled aids on common wheat and rapeseed fell to zero from 2006.

Table EQ3.4: Coupled aids paid for COP crops (€ per hectare)

		2001	2002	2003	2004	2005	2006	2007
Field peas	Seine Maritime			454	448	430	148	*147*
	Eure et Loir	441	469	450	427	416	148	*148*
	Castilla-La Mancha	181	180	180	214		95	*95*
	Niedersachsen	390	385	397	399	56	56	*56*
	East Anglia	411	419	416	402	52	50	*50*
Field beans	Niedersachsen	390	385	397	399	56	56	*56*
	East Anglia	411	419	416	402	52	50	*50*
Common wheat	Seine Maritime			395	394	376	95	*94*
	Eure et Loir	359	381	377	379	364	90	*91*
	Castilla-La Mancha	156	154	158	159		39	*39*
	Niedersachsen	338	339	358	347	0	0	*0*
	East Anglia	357	364	362	349	0	0	*0*
Rapeseed	Seine Maritime			395	394	376	94	*93*
	Eure et Loir	397	365	363	365	347	86	*87*
	Niedersachsen	432	343	356	347	0	0	*0*
	East Anglia	418	364	362	349	0	0	*0*
Sunflower	Castilla-La Mancha	179	150	163	161		39	*39*

Sources: FADN database. *Values in italics are estimates, assuming 2007 values are unchanged from 2006 levels.*

Table EQ3.5 calculates the rotational benefits from higher common wheat yields the year after planting the crops listed in the table. The benefits are valued at local producer prices for wheat. The table also lists the nitrogen savings immediately following the two protein crops

Table EQ3.5: Rotational benefits for the following common wheat crop (€ per hectare)

		2001	2002	2003	2004	2005	2006	2007
Field peas	Seine Maritime			118	62	76	122	96
	Eure et Loir	75	66	82	51	69	100	84
	Castilla-La Mancha	21	24	30	23		38	*27*
	Niedersachsen	78	53	109	57	71	111	122
	East Anglia	95	71	129	59	85	135	*103*
	N Savings	*21*	*21*	*21*	*24*	*30*	*30*	*38*
Field beans	Niedersachsen	78	53	109	57	71	111	122
	East Anglia	95	71	129	59	85	135	*103*
	N Savings	*13*	*13*	*13*	*14*	*18*	*18*	*23*
Common wheat	Seine Maritime							
	Eure et Loir							
	Castilla-La Mancha							
	Niedersachsen							
	East Anglia							
Rapeseed	Seine Maritime			85	45	54	88	69
	Eure et Loir	54	48	59	36	50	72	61
	Niedersachsen	56	38	78	41	51	80	88
	East Anglia	68	51	93	43	61	97	*74*
Sunflower	Castilla-La Mancha	15	17	22	17		27	*20*

Sources: Unkovich & McNeill; CIE; UNIP *op. cit. Values in italics are estimates,*

Note: 2007 rotational benefits in the UK and Spain assume that common wheat yields that year were 2000-2007 averages.

Table EQ3.6 lists the annual producer prices for the different COP crops, while Table EQ3.7 summarises the revenues earned at market prices from the sale of the crops.

Table EQ3.6: Producer prices for COP crops (€ per tonne)

		2001	2002	2003	2004	2005	2006	2007
Field peas	Seine Maritime			129	111	113	129	229
	Eure et Loir	144	122	128	115	111	125	165
	Castilla-La Mancha	168	146	161	152		170	*224*
	Niedersachsen	142	136	115	123	119	117	135
	East Anglia	174	181	206	191	173	190	*250*
Field beans	Niedersachsen	134	129	109	113	118	110	126
	East Anglia	147	120	146	132	127	135	*178*
Common wheat	Seine Maritime			110	91	92	121	170
	Eure et Loir	104	92	106	89	88	110	145
	Castilla-La Mancha	142	130	132	133		146	*192*
	Niedersachsen	105	99	128	96	97	130	234
	East Anglia	131	102	132	102	101	129	*170*
Rapeseed	Seine Maritime			221	192	194	230	280
	Eure et Loir	219	227	224	192	197	230	255
	Niedersachsen	209	232	221	188	200	221	423
	East Anglia	433	369	374	213	212	246	*273*
Sunflower	Castilla-La Mancha	231	247	215	231		182	*202*

Sources: Case study monographs. *Values in italics are estimates,*

Table EQ3.7: Revenues at market prices from COP crops (€ per hectare)

		2001	2002	2003	2004	2005	2006	2007
Field peas	Seine Maritime			698	678	565	645	985
	Eure et Loir	557	620	567	572	497	556	703
	Castilla-La Mancha	46	164	155	225		172	*247*
	Niedersachsen	590	441	421	474	449	414	429
	East Anglia	571	637	818	842	656	664	*938*
Field beans	Niedersachsen	603	514	456	494	505	440	497
	East Anglia	447	482	576	513	458	431	*644*
Common wheat	Seine Maritime			976	894	736	992	1,292
	Eure et Loir	800	793	662	709	639	483	1,069
	Castilla-La Mancha	213	287	251	330		309	*368*
	Niedersachsen	1,019	867	1,147	1,089	925	1,120	1,887
	East Anglia	978	863	1,067	848	868	1,140	*1,434*
Rapeseed	Seine Maritime			974	712	718	713	924
	Eure et Loir	615	792	770	739	822	437	875
	Niedersachsen	985	932	1,005	1,092	997	1,044	1,878
	East Anglia	1,175	1,327	1,344	621	723	838	*893*
Sunflower	Castilla-La Mancha	106	178	177	181		90	*126*

Sources: Case studies. *Values in italics are estimates.*

Table EQ3.8 contains the results of calculations of the gross margins at market prices per hectare on the same crops. These are derived by subtracting the direct costs (in Table EQ3.3) from the revenues at market prices (in Table EQ3.7).

Table EQ3.8: Gross margins (revenues - direct costs) at market prices for COP crops, €/ha.

		2001	2002	2003	2004	2005	2006	2007
Field peas	Seine Maritime			293	250	142	210	507
	Eure et Loir	271	336	295	301	242	294	389
	Castilla-La Mancha	-163	-60	-91	-80		-62	*-38*
	Niedersachsen	251	155	108	149	155	114	80
	East Anglia	276	319	510	531	362	353	*565*
Field beans	Niedersachsen	306	262	167	170	206	132	157
	East Anglia	239	268	380	307	264	230	*402*
Common wheat	Seine Maritime			628	518	359	632	893
	Eure et Loir	433	471	368	371	294	144	704
	Castilla-La Mancha	-29	47	-19	41		23	*58*
	Niedersachsen	473	328	575	487	363	554	1,250
	East Anglia	559	458	691	459	471	728	*991*
Rapeseed	Seine Maritime			637	321	337	303	521
	Eure et Loir	264	472	442	386	454	82	517
	Niedersachsen	456	401	431	466	401	464	1,289
	East Anglia	807	958	1,007	272	351	445	*497*
Sunflower	Castilla-La Mancha	-8	33	18	23		-69	*-35*

Sources: Case studies, and the previous tables. *Values in italics are estimates,*

Adding coupled aids per hectare to the gross margins at market prices generates the full gross margins that are described in Table EQ3.9.

Table EQ3.9: Full gross margins (gross margin plus coupled aids) from COP crops (€/ha.)

		2001	2002	2003	2004	2005	2006	2007
Field peas	Seine Maritime			747	698	572	358	654
	Eure et Loir	712	805	745	728	659	442	537
	Castilla-La Mancha	-8	102	78	115		12	*37*
	Niedersachsen	641	540	505	548	210	170	135
	East Anglia	687	737	926	933	414	403	*615*
Field beans	Niedersachsen	696	647	564	569	261	188	213
	East Anglia	650	687	796	708	316	280	*452*
Common wheat	Seine Maritime			1,023	911	735	727	987
	Eure et Loir	760	830	749	748	672	508	794
	Castilla-La Mancha	100	182	127	181		42	*77*
	Niedersachsen	811	666	933	835	363	554	1,250
	East Anglia	915	822	1,054	809	471	728	*991*
Rapeseed	Seine Maritime			1,033	715	713	397	614
	Eure et Loir	723	869	808	748	819	430	604
	Niedersachsen	888	744	787	813	401	464	1,289
	East Anglia	1,225	1,322	1,370	621	351	445	*497*
Sunflower	Castilla-La Mancha	144	164	170	165		-50	*-16*

Sources: Case studies, and the previous tables. *Values in italics are estimates,*

Table EQ3.10 then adds the rotational benefits (that are derived from Table EQ3.5) to the full gross margins (summarised in Table EQ3.9) to obtain the estimates of incomes per hectare for these crops.

Table EQ3.10: Income (full gross margin plus rotational benefits) from COP crops (€/ha.)

		2001	2002	2003	2004	2005	2006	2007
Field peas	Seine Maritime			886	784	677	510	788
	Eure et Loir	808	892	848	803	758	572	659
	Castilla-La Mancha	33	147	129	162		80	*102*
	Niedersachsen	740	614	635	629	312	311	295
	East Anglia	802	830	1,076	1,016	529	568	*757*
Field beans	Niedersachsen	787	712	685	640	350	317	357
	East Anglia	757	771	938	782	419	433	*579*
Common wheat	Seine Maritime			1,023	911	735	727	987
	Eure et Loir	760	830	749	748	672	508	794
	Castilla-La Mancha	100	182	127	181		42	*77*
	Niedersachsen	811	666	933	835	363	554	1,250
	East Anglia	915	822	1,054	809	471	728	*991*
Rapeseed	Seine Maritime			1,118	759	767	485	684
	Eure et Loir	777	917	867	785	869	502	664
	Niedersachsen	944	782	865	854	452	544	1,376
	East Anglia	1,293	1,374	1,462	663	413	542	571
Sunflower	Castilla-La Mancha	159	181	191	182		-22	*4*

Sources: Case studies, and the previous tables. *Values in italics are estimates,*

The final stage in the calculations for the analysis undertaken applying the first methodology is outlined in Table EQ3.11.

Within this table, two rotations are contrasted.

- The first rotation is a six year rotation comprising wheat x 2/oilseed x 1/wheat x 2/protein crop x 1, which is repeated every six years.
- The second is a simpler three year rotation of wheat x 2/oilseed x 1, and this rotation is then repeated.

In both cases, these calculations are prepared on the basis of annual averages over the full rotation cycle.

In each rotation, the calculations of total incomes for an individual year are made applying only the prices, costs, yields and coupled payments that were recorded for that particular year. In other words, the rotation is not averaged over six consecutive years (2001-2006, for example).

This assumption is made because producers cannot be assumed to project prices, coupled aids, yields and costs into the future in a manner that associates rotational benefits with future changes in all these variables.

Instead, producers are likely to base their decisions regarding protein crop plantings and rotational benefits on the current information in the year in which they are making their production decisions.

The last part of the same table summarises the arithmetic differences, by year, by region and by protein crop, between the average annual incomes under the two rotations to identify the average advantage (or, more typically, disadvantage, which is indicated with a minus sign) for the rotation that includes protein crops.

Table EQ3.11: Comparison of incomes on two wheat rotations, one a six year rotation with protein crops, the other a three year rotation with oilseeds (€ per hectare per year)

		2001	2002	2003	2004	2005	2006	2007
Average total incomes per annum over six year rotation - wheat x 2/oilseed x 1/wheat x 2/protein crop x 1								
Field peas	Seine Maritime			1,016	865	731	650	903
	Eure et Loir	771	855	785	763	719	518	750
	Castilla-La Mancha	125	195	150	196		58	*89*
	Niedersachsen	821	677	872	804	370	512	1,112
	East Anglia	960	915	1,126	819	471	670	*882*
Field beans	Niedersachsen	829	693	880	805	376	513	1,122
	East Anglia	952	905	1,103	780	453	648	*852*
Average total incomes per annum over three year rotation - wheat x 2/oilseed x 1								
Rapeseed	Seine Maritime			1,054	861	746	646	886
	Eure et Loir	766	859	788	760	738	506	751
	Niedersachsen	855	705	910	841	393	550	1,292
	East Anglia	1,041	1,006	1,190	760	452	666	*851*
Sunflower	Castilla-La Mancha	146	200	160	200		40	*73*
Average advantage per annum per hectare for rotation including protein crops								
Field peas	Seine Maritime			-39	4	-15	4	17
	Eure et Loir	5	-4	-3	3	-19	12	-1
	Castilla-La Mancha	-21	-6	-10	-3		17	*16*
	Niedersachsen	-34	-28	-38	-38	-23	-39	-180
	East Anglia	-82	-91	-64	59	19	4	*31*
Field beans	Niedersachsen	-26	-12	-30	-36	-17	-38	-170
	East Anglia	-89	-101	-87	20	1	-18	*1*

Sources: Case studies. *Values in italics are estimates,*

2.3.3. Application of the second methodology

The results of the application of the second methodology are summarised in Table EQ3.12. In this case, the incomes per hectare from protein crops (including both rotational benefits and coupled aids) are compared with the weighted average incomes per hectare from other COP crops in the same region.

The weighted average incomes from "other COP crops" incorporate their own coupled aids, and also the rotational benefits received from oilseeds (this is attributed solely to the oilseed share of the other COP crop area). The weights in each case are the areas planted to the individual crops each year, and the direct costs and revenues for those COP crops that were not included in the earlier tables[48] are obtained from the case studies.

In the East Anglia and Niedersachsen examples, field beans are alternatives to field peas and *vice versa*. So, the "other COP crop" income estimate includes the alternative protein crop in the calculation of "other COP crops". Thus, it is assumed that farmers when deciding whether to grow, say, field peas in Niedersachsen or East Anglia, takes into consideration the alternative option of growing field beans.

[48] These include feed and malting winter and spring barley; maize; oats and bitter vetch.

For presentational simplicity, Table EQ3.12 includes the "other COP crop" income calculation only for the comparison with field peas. The corresponding figures for field beans for Niedersachsen and East Anglia are only very slightly different.

The lowest block of rows in the table summarises the arithmetic difference between the income per hectare from field pea production and the weighted average income per hectare on alternative COP crops in the same region. Negative values indicate that other COP crops, averaged over the alternatives available to field pea producers in the same region, generate higher incomes per hectare than field peas.

Table EQ3.12: Income from protein crops vs. weighted average income from other COP crops, including rotational benefits on oilseed share of other COP areas (€ per hectare)

		2001	2002	2003	2004	2005	2006	2007
Field peas	Seine Maritime			886	784	677	510	788
	Eure et Loir	808	892	848	803	758	572	659
	Castilla-La Mancha	59	165	140	180		100	*122*
	Niedersachsen	740	614	635	629	312	311	295
	East Anglia	802	830	1,076	1,016	529	568	*757*
Field beans	Niedersachsen	787	712	685	640	350	317	357
	East Anglia	757	771	938	782	419	433	*579*
Other COP crops	Seine Maritime			998	860	740	646	900
	Eure et Loir	769	842	753	796	762	487	709
	Castilla-La Mancha	159	212	183	261		68	*57*
	Niedersachsen	811	746	849	757	390	623	995
	East Anglia	888	854	1,035	748	438	657	*615*
Average advantage per annum per hectare for field peas								
	Seine Maritime			-112	-76	-62	-136	-112
	Eure et Loir	39	50	95	7	-4	85	-50
	Castilla-La Mancha	-99	-47	-42	-80		32	*66*
	Niedersachsen	-71	-133	-214	-128	-78	-312	-700
	East Anglia	-86	-24	42	268	91	-89	*142*

Sources: Case studies. *Values in italics are estimates,*

3. The effects of the 2003 reform on the competitiveness of protein crops

The competitiveness of protein crops to producers is assumed to be measured by its profitability (reflected in their full gross margins per hectare, including coupled aids in the revenues) vs. alternative crops.

3.1. Changes in the full gross margins on protein crops and other COP crops

In Table EQ3.13, derived from the analysis of full gross margins in each of the case study monographs, differences between full gross margins for protein crops, on the one hand, and the weighted average of full gross margins for other major COP crops (where the weights are their planted areas), on the other, are contrasted with the annual relative changes in the share of protein crops in the total COP crop area one year later, since planting decisions are assumed to reflect the experience of the latest completed harvests.

It is important to stress that this particular comparison does not incorporate the externalities associated with protein crop production from nitrogen fixation and higher yields benefiting the crop following them in the rotation. The impact of these externalities is analysed below.

In the table, the comparisons between area changes and difference in full gross margins are made in three periods: before 2004 (up until and including 2003); just after the reform (2004-2005); and more recently (from 2006). The last period is included separately to enable one to assess the outcome after the full implementation of the SPS.

It is assumed that the relevant indicator of changes in protein crop plantings is not absolute changes in their share of overall COP crop areas (since such absolute changes are typically small), but is the proportional change in the share of COP areas committed to protein crops.

In other words, the relevant indicator of producer responses to different influences (market forces, policy measures, weather, etc.) would, for example, be the 40% reduction from, say, 2,500 to 1,500 hectares in protein crop areas within a total COP area of 100,000 hectares, rather than the much more modest figure of a 0.1% decline, from 0.25% to 0.15% in the proportion of the COP crop area planted to protein crops.

Table EQ3.13: Difference between full gross margins, €/ha, (GM) on protein crops and on other COP crops vs. relative changes in the protein crop share of COP areas a year later

	Years of gross margin data		
Seine Maritime, France - Field peas	2003	2004-2005	2006-2007
GM difference, field peas vs. other COP crops	-237	-156	-252
Annual relative change in field pea % of COP crop area	-6.8%	-20.0%	-28.2%
Eure-et-Loir, France - Field peas	2001-2003	2004-2005	2006-2007
GM difference, field peas vs. other COP crops	-23	-76	-93
Annual relative change in field pea % of COP crop area	-4.8%	-15.7%	-36.9%
Castilla la Mancha, Spain - Field peas	2001-2003	2004-2005	2006
GM difference, field peas vs. other COP crops	-110	-129	-33
Annual relative change in field pea % of COP crop area	11.1%	-5.0%	-6.4%
East Anglia, UK - Field peas	2001-2003	2004-2005	2006
GM difference, field peas vs. other COP crops	-134	89	-234
Annual relative change in field pea % of COP crop area	-16.7%	-10.2%	-14.1%
Niedersachsen, Germany - Field peas	2001-2003	2004-2005	2006-2007
GM difference, field peas vs. other COP crops	-236	-189	-638
Annual relative change in field pea % of COP crop area	-12.7%	-40.0%	-39.3%
East Anglia, UK - Field beans	2001-2003	2004-2005	2006
GM difference, field beans vs. other COP crops	-205	-74	-358
Annual relative change in field bean % of COP crop area	17.1%	38.0%	-6.5%
Niedersachsen, Germany - Field beans	2001-2003	2004-2005	2006-2007
GM difference, field beans vs. other COP crops	-162	-153	-589
Annual relative change in field bean % of COP crop area	-5.0%	3.2%	-22.9%

Source: Derived from the data presented above and in the discussion of EQ1 and analysed in the case study monographs.
Notes: The GM difference equals the GM on protein crops *minus* the weighted average GM on other COP crops, where the weights are the areas under the individual COP crops. The relative change in the protein crop share of COP areas always refers to the year after the one for which the gross margins are computed.
Comprehensive data series are only available for the four EU-15 case study MS (France, Germany, Spain and the UK).

The main conclusions that emerge from Table EQ3.13 are:

- In all but one of the seven sets of regional data regarding full gross margins and area changes (the exception is in the case of field peas in Castilla-La Mancha), the full gross margins for protein crops in the most recent period (2006 or 2006-2007) were at a larger discount vis-à-vis other COP crops than they were prior to the reform.
- Thus, there was a deterioration in the competitive position of protein crops, where their attraction to producers is assessed purely in terms of full gross margins. (In the next two sections, we consider other aspects of competitiveness, notably risks in production, full gross margin and income, and also the externalities in crop rotations.)
- In only one of the 21 permutations of years, crops and regions listed in the table did a protein crop generate a higher average full gross margin than the weighted average figure for other major COP crops. This was for East Anglian field peas in 2004-2005.
- In only four of the same 21 permutations of years, crops and regions was there an increase in the relative share of the protein crop. Of these, three applied to field beans, while the other related to field peas in Castilla-La Mancha in 2001-2003.

3.2. Analysis of incomes per hectare

Further understanding of the change in area and production may be gained by examining incomes for protein crops from 2001 to 2007. This analysis is introduced in this chapter, and is considered further in the next. The section also reviews the ways in which incomes, relative profitability and planted areas have changed for the main competing crops in this period.

The discussion includes an analysis of externalities from the rotation benefits associated with protein crops, both in nitrogen-fixing and in boosting the next year's yields for wheat planted in the year after protein crops. This impact is quantified under two methodologies, as explained earlier in this chapter. In the first, two full rotation cycles are compared, one a six year cycle in which two years of common wheat are followed by one year of protein crops; this is followed by two more years of common wheat, with the final year one of rapeseed. In the second methodology, it is assumed that producers quantify the externality for a following common wheat crop from planting protein crops and compare the income on the protein crop (including this benefit), with the weighted average income (using areas as weights) of the alternative COP crops. This is intended to represent the typical alternative open to a producer who adopts opportunistic behaviour in protein crop farming decisions.

The comparison of incomes over the two alternative six year rotation cycles, one with only common wheat and rapeseed, the other with common wheat, rapeseed and field peas, applying the first methodology, is summarised in Table EQ3.14. The differences between the two full rotations' incomes are relatively modest. This is because the two rotations differ only one year in six, when protein crops are planted, instead of oilseeds. Since gross margins are averaged over six years, it may be deduced that the arithmetic difference between the results for the two alternative rotations is just one sixth of the difference between a single year's protein crop and rapeseed gross margins, taking account of rotational externalities.

In 2001-2003, none of the protein crop rotations generated a positive net advantage over the rotation including oilseeds. In 2004-2007, Seine Maritime, Castilla-La Mancha and East Anglian field peas all recorded a positive net advantage over the alternative rotation. For field beans in East Anglia, there was a net advantage for the protein crop rotation of €1 per hectare. In all, there was an improvement in the competitive position of the protein crop rotation in four of the seven region-protein crop combinations after 2003.

Table EQ3.14: Comparing regional incomes, 2001-2003 and 2004-2007, under two alternative crop rotations, one with protein crops and one with only rapeseed (€/ha.)

(A) Field peas		Income	Income	Field pea area
Region	Full six year rotations	2001-2003	2004-2007	change 2004-2007
Seine Maritime	Rotation without field peas	1,054	785	-24.1%
France	Rotation with field peas	1,016	787	
	Net advantage for field pea rotation	-39	3	
Eure et Loir	Rotation without field peas	804	689	-26.3%
France	Rotation with field peas	804	688	
	Net advantage for field pea rotation	-1	-1	
Castilla-La Mancha	Rotation without field peas	169	104	-5.5%
Spain	Rotation with field peas	156	114	
	Net advantage for field pea rotation	-12	10	
East Anglia	Rotation without field peas	1,079	682	-11.5%
UK	Rotation with field peas	1,000	711	
	Net advantage for field pea rotation	-79	28	
Niedersachsen	Rotation without field peas	824	769	-39.6%
Germany	Rotation with field peas	790	699	
	Net advantage for field pea rotation	-33	-70	
(B) Field beans		Income	Income	Field bean area
Region	Rotation	2001-2003	2004-2007	change 2004-2007
East Anglia	Rotation without field beans	1,079	682	-16.7%
UK	Rotation with field beans	987	683	
	Net advantage for field bean rotation	-92	1	
Niedersachsen	Rotation without field beans	824	769	-9.9%
Germany	Rotation with field beans	801	704	
	Net advantage for field bean rotation	-23	-65	

Sources: Analysis of data from case study monographs

The other approach employed in the analysis compares actual incomes on protein crops, including rotational benefits for the following crop, with weighted average incomes on other COP crops, allowing for rotational benefits from oilseeds. The hypothesis in this case was that relative incomes one year determine the protein crop shares of total COP areas the next year, i.e., an adaptive expectation model. The results are listed in Table EQ3.15, where the period after 2004 was divided into two in this analysis, 2004-2005 and 2006-2007. This was in order to distinguish the last two years, when the SPS had been introduced in all four MS in the sample.

One observes from this comparison that, despite strong growth in the net rotational benefits for protein crops over the period under review, the net advantage for protein crops over other COP crops worsened in 2006-2007 in all but one (Castilla-La Mancha/field peas) of the region-crop combinations in the table.

At the same time, all but one of the seven categories experienced a worsening of the relative area change for the protein crop in question (i.e., it declined by a larger percentage in 2006-2007 than it had done in 2004-2005). Niedersachsen/field beans was the one exception, but even there, the relative area decline was large, and was near 40% in both 2004-2005 and in 2006-2007. This may seem to suggest that there is a link between changes in the net advantage for protein crops and changes in their relative areas a year later; but examination of the movements in net advantages and relative area changes between 2001-2003 and 2004-2005 shows no convincing support for such a correlation over other periods. Four of the seven categories recorded a change in the net advantage for protein crops that moved in the same direction as the relative area change between 2001-2003 and 2004-2005. These were Eure et Loir, Castilla-La Mancha and East Anglia for field peas, and East Anglia for field beans.; but the other three region-crop combinations saw the two variables move in opposite directions.

Table EQ3.15: Comparison of regional full gross margins and incomes, before and after 2004, for protein crops and other COP crops (€ per hectare)

Seine Maritime, France	2003	2004-2005	2006-2007
Full gross margin, field peas	747	635	506
Full gross margin, other COP crops	985	791	758
Net rotation benefits for field peas	131	91	133
Net income advantage for field peas	***-107***	***-66***	***-119***
Relative area change one year later	*-6.8%*	*-20.0%*	*-28.2%*
Eure et Loir, France	2001-2003	2004-2005	2006-2007
Full gross margin, field peas	754	694	489
Full gross margin, other COP crops	808	772	895
Net rotation benefits for field peas	90	82	118
Net income advantage for field peas	***36***	***3***	***-288***
Relative area change one year later	*-4.8%*	*-15.7%*	*-36.9%*
Castilla-La Mancha, Spain	2001-2003	2004	2006-2007
Full gross margin, field peas	76	134	44
Full gross margin, other COP crops	186	263	78
Net rotation benefits for field peas	44	45	65
Net income advantage for field peas	***-66***	***-84***	***32***
Relative area change one year later	*11.1%*	*-5.0%*	*-6.4%*
East Anglia, UK	2001-2003	2004-2005	2006-2007
Full gross margin, field peas	783	674	509
Full gross margin, other COP crops	917	584	742
Net rotation benefits for field peas	111	91	139
Net income advantage for field peas	***-23***	***180***	***-94***
Relative area change one year later	*-16.7%*	*-10.2%*	*-14.1%*
Niedersachsen, Germany	2001-2003	2004-2005	2006-2007
Full gross margin, field peas	562	379	152
Full gross margin, other COP crops	798	569	790
Net rotation benefits for field peas	93	84	135
Net income advantage for field peas	***-144***	***-105***	***-502***
Relative area change one year later	*-12.7%*	*-40.0%*	*-39.3%*
East Anglia, UK	2001-2003	2004-2005	2006-2007
Full gross margin, field beans	711	512	366
Full gross margin, other COP crops	916	586	725
Net rotation benefits for field beans	103	80	126
Net income advantage for field beans	***-102***	***7***	***-233***
Relative area change one year later	*17.1%*	*38.0%*	*-6.5%*
Niedersachsen, Germany	2001-2003	2004-2005	2006-2007
Full gross margin, field beans	635	415	200
Full gross margin, other COP crops	797	568	789
Net rotation benefits for field beans	84	73	122
Net income advantage for field beans	***-77***	***-80***	***-468***
Relative area change one year later	*-5.0%*	*3.2%*	*-22.9%*

Sources: Analysis of data from case study monographs

Notes:
1. The full gross margins for protein crops and other COP crops do not include any benefits from crop rotations.
2. The net rotation benefits for protein crops = the rotation benefits for protein crops *minus* the rotation benefits for other COP crops that arise from the use of oilseeds as a rotation crop in a mainly cereal cycle.
3. The net income advantage for protein crops equals the full gross margin on protein crops *plus* net rotation benefits for these crops *minus* the full gross margin on other COP crops.
4. The relative area change one year later is the proportional change in the protein crop share of total COP crop areas one year after the period to which the gross margins refer.

3.2.1. Analysis of changes in areas planted to protein crops

In this section, we consider whether the incorporation of the rotational benefits from protein crops into the analysis, so as to generate estimates of incomes per hectare, yields a statistically significant relationship between the difference between the incomes per hectare on protein and that on other COP crops, on the one hand, and relative changes in the areas planted to protein crops one year later. We prepare this analysis applying each of the methodologies for assessing rotational benefits that were described earlier in this chapter, We do so over the period, 2004-2007, i.e., after the 2003 reform.

Table EQ3.16 lists in the first column the income advantage for protein crops over the average income for other COP crops, applying the second of the methodologies described earlier. The second column lists the advantage for a six year (wheat x 2 – rapeseed x 1-wheat x 2- field pea x 1) rotation, which includes protein crops, over the alternative rotation (wheat x 2 – rapeseed x 1) that excluded protein crops. The final column indicates the proportional change in the protein crop share of total COP crop areas from 2001-2003 to 2004-2007.

Table EQ3.16: Income advantage, in €/ha., for rotations that include protein crops over rotations without them vs. relative protein crop area change, 2004-2007

		2004-2007 protein crop advantage		Area change
		vs. other COP	vs. alternative rotation	2001-2003 to 2004-2007
Field pea	Seine Maritime	-92	3	-24.1%
	Eure et Loir	-142	-1	-26.3%
	Castilla-La Mancha	-26	10	-5.5%
	East Anglia	43	28	-11.5%
	Niedersachsen	-304	-70	-39.6%
Field bean	East Anglia	-113	1	-16.7%
	Niedersachsen	-274	-65	-9.9%

Source: Derived from the preceding tables and data presented in the case study monographs.

Note: The first column "vs. other COP", compares the full gross margin *plus* net rotational benefits from one year of the protein crop with the weighted average gross margin on other COP crops. The second column represents the average annual difference between full gross margins in a six year cycle of 2:1:2:1 wheat: rapeseed: wheat: protein crop and one of 2:1:2:1 wheat: rapeseed: wheat: rapeseed.

One hypothesis to explain the different outcomes in different regions is that a larger income advantage for protein crops would yield a larger relative increase in protein crop areas, *ceteris paribus*. Therefore, we undertook linear regression analysis of the relationships between the 2004-2007 protein crop advantage under each methodology and average area changes.

Analysing the relationship using the data in the first column to measure the income advantage for field peas, we obtained the following result:

Relative change in field pea area = -0.12 + 0.00094 x Field pea income advantage

(t-value 3.3) (t-value 4.2)

Adjusted $R^2 = 0.804$ Significance F = 0.025096

Applying the data in the second column, where the income advantage is calculated by comparing two alternative (six year and three year) rotations, we derive:

Relative change in field pea area = -0.195 + 0.00305 x Field pea income advantage

(t-value 5.3) (t-value 2.9)

Adjusted $R^2 = 0.643$ Significance F = 0.064394

These equations have the expected positive signs for the income advantage term (coefficients are 0.00094 and 0.00305, respectively), but the concerns about the precision of the income estimates on which the analysis is based (which combine assumptions about externalities from crop rotations with estimates of revenues at market prices and direct production costs for different COP crops) mean that caution should be taken when drawing conclusions from the fairly good statistical significance of the R^2 and F test values for the equations.

Since there are only two regions for which field bean data are available, there are insufficient data points from which to estimate a statistically significant relationship.

3.3. The effect of full decoupling on protein crop gross margins and output

The first of these two regression analyses derived applying data from the first column of Table EQ3.16 may be used as a basis to assess the effects of specific changes in incomes as a result of changes in the measures in the protein crop sector, in particular, the counterfactual case of the removal of all coupled aids on protein crops.

The coefficient estimated in linear regression analysis implies that each €10 reduction in the gross margin on field peas causes a reduction of 0.94% in the total area planted to field peas in the following year. Therefore, a €55.57 reduction in coupled aids (i.e., their complete elimination in the EU-15 MS) would generate a 5.2% overall reduction in the field pea area in those MS. (This is derived as 0.094% of 55.57.)

In this analysis, it should be noted that the coupled aids paid in both France and Spain are higher than those in other EU-15 MS, by virtue of the decision by these MS to opt to retain 25% of the arable aids from the previous measures as coupled aids. However, since the retained 25% of the arable aids is paid equally on both protein crop and other COP crop areas, it does not introduce any bias in favour of, or against, protein crops. Thus the removal of this component of coupled aids should not affect the difference in income per hectare between protein crops and other COP crops.

Subject to caveats about the precision of such figures, in view of the potential weakness of the underlying data, the analysis would imply that full decoupling would cause a 5.2% reduction in the EU-15 field pea area vs. the area that exists where special aids continue to be paid.

Taking the 2007 total area under protein crops in the EU-15 as the starting point (since the removal of coupled aids would have a minimal effect on the EU-12), and assuming that the reduction in area applied equally to all protein crops (though there is no basis for believing that the analysis for field peas applies equally to the other two protein crops), then the ending of coupled aids would reduce the protein crop area by the equivalent of 5.2%, or approximately 44,000 hectares, and lower the output of protein crops by 115,000 tonnes.

The second equation averages the revenues over a six year cycle including one year of protein crops. In this approach, the elimination of coupled aids would reduce the average annual income over that six year cycle by €55.57/6 = €9.26 per annum. This would imply that full decoupling would reduce the EU-15 field pea area by 0.00305 x 9.26 = 2.8% when contrasted with the area where special aids are still paid. If applicable to the other two protein crops, the second approach would imply that full decoupling would reduce the EU-15 protein crop area by only 24,000 hectares and production by 62,000 tonnes below the 2007 levels.

In addition, there was inconclusive evidence, presented earlier, that the 2003 measures provided minor encouragement to expand protein crop areas in regions with low yields and provided minor discouragement in regions with above average yields, but we concluded that the main causes of the changes witnessed in protein crop areas after 2003 were other external factors, including CAP measures in other sectors, such as the CAP energy crop measures.

3.3.1 Analysis of producer questionnaire responses

An alternative approach to estimating the impact of full decoupling upon protein crop areas is provided by the questionnaires completed by producers in six member states, four in the EU-15, who receive the €55.57 special aid, and two in the new MS, who receive no special aids. The producers were asked how they would change their protein crop areas if the coupled payment were set at €100, €75, €50, €25 or zero per hectare. For the four EU-15 MS, the question about the €50 special aid was dropped since that is close to the current situation; for the two EU-12 MS, the question about the zero aid was dropped for the same reason.

The interpretation to be placed on the increases of 12.9% and 10.0% in Polish and Hungarian protein crop areas is that, if a €50 per hectare coupled payment were paid, these two EU-12 MS, which now receive no coupled aid, would expand their areas if this aid were introduced.

The results were analysed by MS and in aggregate, and the changes in areas that would occur at the different levels of coupled payments are summarised in Table EQ3.17. (Percentage changes in both are to be interpreted in a similar way to the relative changes in areas, i.e., they measure the proportional change in the areas under protein crops as a share of COP crops, not the change in the absolute share of the farm area devoted to protein crops.)

While the results of this simulation provide useful insights into the potential behaviour of protein crop farmers following changes in the amount of aids linked to protein crops, it is important to point out that these evidence can only be interpreted in relation to the farmers who responded to this particular question during the fieldwork[49].

Due to the way in which protein crop farmers were selected in the six case study MS, this sample is not representative of the population of EU farmers growing protein crops. Thus, the results of this analysis should be interpreted with caution as they may not reflect the behaviour of EU protein crop farmers as a whole.

The key results of our simulation are that:

- UK producers are least sensitive to the coupled payment. This may be because they sell a large share of their output to markets that pay a premium above feed grade prices.
- French producers are less keen than their counterparts elsewhere to maintain their areas under protein crops. Interviews suggest that this is a response to *aphanomyces*.
- Producers in the new MS are responsive to low levels of coupled payments. This is presumably because they currently receive no coupled special aids on protein crops.
- Where the answers by MS are weighted by each MS's share of total protein crop area in 2008/09, as is done in the last row of Table EQ3.18, we observe that the protein crop areas would be expected to fall by 8.6% in the event of full decoupling.
- This figure of 8.6% may be compared with drops of 5,2% or 2.8% for field peas derived from analysis of the data in Table EQ3.16, which not only have high margins of error associated with them, but which also take 2006-2007 data as a starting point, whereas the questionnaires completed in 2009, take 2008/09 areas as a basis for comparison.
- If the decline of 8.6% is applied to the full EU-27 protein crop area of 0.84 million hectares in 2008/09, it would imply that full decoupling would reduce the EU-27 protein crop area by 72,000 hectares.

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[49] The 116 respondents comprised France, 18; Germany, 26; Hungary, 24, Poland, 10; Spain, 25; UK, 13.

- This loss of area would reduce production by 219,000 tonnes, if the average EU-27 yields observed from 2000 to 2007 of 3.02 tonnes per hectare were applied.

Table EQ3.17: Relative changes in the protein crop area as a share of COP crop areas by Member State for different levels of coupled protein crop payment per hectare

	€100/ha	€75/ha	€50/ha	€25/ha	Zero
France	26.2%	13.6%		-9.2%	-15.0%
Germany	35.8%	31.0%		-1.5%	-8.5%
Hungary	31.0%	26.5%	12.9%	0.0%	
Poland	35.0%	25.0%	10.0%	5.0%	
Spain	31.0%	26.5%		0.0%	-13.9%
UK	16.7%	6.7%		0.0%	0.0%
Total	30.1%	22.6%		0.6%	-8.1%
Weighted average	***27.3%***	***18.6%***	***1.2%***	***-2.4%***	***-8.6%***

Source: Analysis of producer questionnaires
Note: The weighted average change is calculated by weighting the changes for each MS by its share of protein crop areas in 2008/-09. (The six MS represented approximately 75% of the EU-27 area in 2008/09.)
The blank cells correspond to the current situation (€55.57 per hectare in the EU-15 MS and zero coupled aid in Hungary and Poland). In these cases, no change in areas should occur if the status quo is maintained.

3.4. The volatility of gross margins

Interviews with producers revealed a perception that field peas are risky, as regards full gross margins and yields, and that this has reduced its competitiveness among COP crops.

Table EQ3.18 compares the coefficients of variation of full gross margins for protein crops and other COP crops. The series run from 2000 to 2007, except for Castilla-La Mancha, which excludes data for 2005, and Seine Maritime, for which the series begins in 2003. Unfortunately, the time series are too short to permit statistically significant analysis of volatility for two shorter periods, one until 2003 and the other after the 2003 reform.

The comparison reveals that protein crops and oilseeds are typically the riskiest in terms of full gross margins. However, a relevant factor for rapeseed is that a sizeable proportion was grown on set-aside land, where the main alternative was to leave the land fallow, with a much lower margin, which probably reduced the significance of the high risk for rapeseed farming.

Table EQ3.18: Coefficients of variation of full gross margins for protein and COP crops

	Field beans	Field peas	Common wheat	Barley	Rapeseed	Maize	Sunflower
Niedersachsen	45.8%	50.6%	33.9%	20.8%	35.4%	45.5%	
Castilla-La Mancha		78.2%	41.5%	48.4%			73.8%
Seine Maritime		25.2%	15.8%	17.9%	33.0%		
Eure-et-Loir		32.3%	28.9%	22.3%	21.7%		
East Anglia	36.2%	31.3%	23.0%	21.0%	49.4%		

Source: Derived from regional data presented earlier in this chapter
Note: The coefficient of variation equals the standard deviation divided by the arithmetic mean

4. Impact of other CAP measures since 1993 on protein crop area decisions

This section analyses the impact of the wider CAP measures in the protein crop and cereals sectors since 1993 and demonstrates how the reforms have affected the relative profitability of production in these two sectors, taking field peas and common wheat as the crops analysed in each sector. It compares the EU experience with that of Canada, the world's leading field pea producer, using the data in the Canadian case study appendix as a basis.

The analysis makes a synthesis from the data on production costs and rotational benefits from the case study MS presented in earlier tables in this discussion of EQ3.

It uses this information to arrive at the following simplified assumptions, which, we stress, are intended primarily to provide insights into the manner in which the measures in the protein crop and cereal sectors, as well as external developments, notably changes in world market prices, affected the relative profitability of protein crops vs. cereals:

1. The benefits in terms of nitrogen-fixation from field peas are the same in all countries. Evidence from Canada and from high and low-yielding regions of the EU is that the benefits in kg of N for the next crop are comparable in different agricultural systems.
2. The wheat crop following immediately after a field pea crop enjoys a yield boost of 9.5% (this is the average from case study data). Therefore, regions with high cereal yields enjoy more financial benefit from this boost than low-yielding regions.
3. The production costs of both wheat and field peas per hectare at different yields are derived from econometric analysis of average direct production costs in 2001-2006 for the five case study regions for which time series exist.

The data on production costs and yields are listed in Table EQ3.19. Linear regressions were prepared relating direct costs per hectare to average yields for the two crops, and the results are summarised after the table. The resulting coefficients on the yield terms were not statistically significant. Therefore, we have simply assumed that there are constant direct costs per hectare for both crops, without sensitivity to yields, and set these at the average levels observed over these years.

We applied in the simulation average direct costs per hectare of field peas of €314 and per hectare of common wheat of €388. This is because average direct costs of field peas were €310 in 2001-2003 and €318 in 2004-2006, giving an overall average of €314. For common wheat the corresponding figures were €380 and €397. Producer prices for common wheat and field peas during the evaluation period in these regions are listed in Table EQ3.6.

Table EQ3.19: Direct costs and yields of protein crops and common wheat, 2001-2003 and 2004-2006 in the five case study MS (€ per hectare, and tonnes per hectare)

		2001-2003	2001-2003	2004-2006	2004-2006
		Yields	Costs	Yields	Costs
Field peas	Seine Maritime	5.40	405	5.37	429
	Eure et Loir	4.28	281	4.13	263
	Castilla-La Mancha	0.91	245	1.03	289
	Niedersachsen	3.68	313	3.72	306
	East Anglia	3.59	307	3.90	306
Field beans	Niedersachsen	4.23	279	4.22	310
	East Anglia	3.67	206	3.57	201
Common wheat	Seine Maritime	8.90	348	8.67	371
	Eure et Loir	7.53	328	7.77	341
	Castilla-La Mancha	2.38	270	2.25	296
	Niedersachsen	7.06	552	7.57	577
	East Anglia	8.03	400	8.33	399

Sources: Case study monographs

4.1 Analysis of direct costs for wheat and field peas, 2001-2003 and 2004-2006

Analysing the relationship between direct costs per hectare for common wheat and the average yields for each region in 2004-2006, we obtained the following result:

Direct costs per hectare = 274.0 + 17.75 x Average yield of common wheat

(t-value 1.78) (t-value 0.84)

Adjusted $R^2 = -0.079$ Significance F = 0.46227

Analysing the same relationship in 2001-2003, we derive:

Direct costs per hectare = 262.4 + 17.28 x Average yield of common wheat

(t-value 1.66) (t-value 0.78)

Adjusted $R^2 = -0.108$ Significance F = 0.491586

Where we analysed the relationship between direct costs per hectare for field peas and the average yields for each region in 2004-2006, we obtained the following result:

Direct costs per hectare = 234.3 + 23.19 x Average yield of field peas

(t-value 3.16) (t-value 1.22)

Adjusted $R^2 = 0.109$ Significance F = 0.309586

Analysing the same relationship in 2001-2003, we derive:

Direct costs per hectare = 203.9 + 29.75 x Average yield of field peas

(t-value 4.55) (t-value 2.57)

Adjusted $R^2 = 0.584$ Significance F = 0.082486

4.2 Simple simulations of CAP reforms in the cereals and protein crop sectors

It is assumed in the simulations that the two main CAP policy reforms that affected the profitability of protein crops vs. cereals in the EU-15 MS were the changes in coupled payments for cereals and protein crops, and the decline in cereal intervention prices since 1993. In the background, there were the movements in world market prices, which become increasingly important in the cereal sector as intervention prices were reduced.

In Diagram EQ3.1, we illustrate how changes in these policy measures and world market prices affected the relative profitability of field peas vs. common wheat, as measured by the full incomes per hectare on the two crops. This is reflected in the values plotted on the Y-axis, which measures the difference between the income earned per hectare of field peas (including coupled aids and rotational benefits) and that on common wheat at different dates.

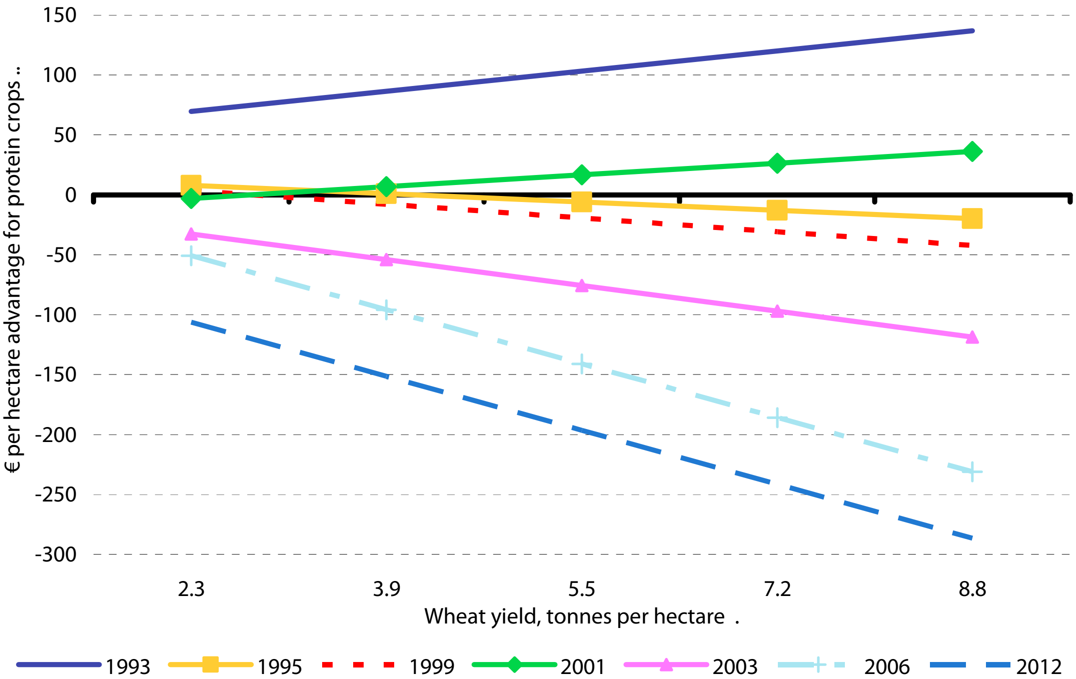
In the diagram, whose data are listed in Table EQ3.20, the low yield values represent Castilla-La Mancha, Spain, with an average common wheat yield of 2.3 tonnes/hectare and a field pea yield of 1.0 tonne/hectare. The high yield example is Seine Maritime in France, with an average wheat yield of 8.8 tonnes/hectare and a field pea yield of 5.4 tonnes/hectare. The reference yields that determined coupled payments in the analysis are set at the actual levels of 2.9 tonnes per hectare in Castilla-La Mancha and 6.6 tonnes per hectare in Seine Maritime. A straight line is drawn between the two points representing these two regions.

French producer prices for field peas and common wheat in feed uses are the market prices in the simulation, and the value of nitrogen fixation is assumed to follow the actual movements in nitrogen fertiliser prices.

In some periods, prices and/or supports were changing fast. To avoid making the diagram over-complicated, we have illustrated the trade-offs in relative profitability in the following periods:

- 1993-1994 (depicted by the legend 1993), at the time of the MacSharry reform;
- 1995-1996 (depicted by the legend 1995), when the MacSharry reform measures were in effect;
- 1999, at the time of the Agenda 2000 reform measures;
- 2001, when the Agenda 2000 measures were fully in effect;
- 2003, the time of the reform covered in the current evaluation;
- 2006-2007 (depicted by the legend 2006), when the SPS system was fully implemented; and
- 2012, which applies exactly the same set of prices as the 2006-2007 simulation, but it assumes that, following the Health Check reform, the special aid of €55.57 per hectare for protein crops no longer applies.

Diagram EQ3.1: The impact of actual crop prices and coupled payment changes on field pea income per hectare advantage vs. wheat, 1993-2012, at different yields, over time



Source: Derived from data in case study monographs, applying intervention prices from DG Agri

Table EQ3.20: Simulation of the net advantage in incomes per hectare for field peas over common wheat, at different cereal yields, 1993-2012 (€ per hectare)

Cereal yield, t/ha.	2.3	3.9	5.5	7.2	8.8
1993-94	69.6	86.4	103.3	120.1	137.0
1995-96	7.9	0.9	-6.0	-12.9	-19.9
1999	3.6	-7.9	-19.4	-30.8	-42.3
2001	-2.9	6.9	16.6	26.4	36.2
2003	-32.6	-54.1	-75.6	-97.2	-118.7
2006-07	-50.8	-95.9	-141.0	-186.1	-231.2
2012	-106.4	-151.5	-196.6	-241.6	-286.7

4.3. Results of the simulation

As cereal intervention prices have been reduced, they have played progressively less of a role in determining domestic prices. Therefore, in recent years, yields of the different crops, world market prices, direct costs and coupled payments have been the main factors determining the relative profitability of protein crops and cereals. The simulation implies that:

For higher yielding regions of the EU, only in 1993 and again in 2001 was it more profitable to grow field peas than common wheat. Field peas were consistently at a sizeable disadvantage against wheat in other years in higher yielding regions, and the competitive disadvantage of field peas vs. wheat became progressively larger over time, and will increase further in 2012.

In the lowest yielding regions, field peas became uncompetitive to a large extent with wheat only from 2003. Since then, the disadvantage has grown, and will widen further after 2012.

In view of this conclusion, it is valuable to note that, among the three high yielding MS included in case studies, the area under protein crops peaked relatively early. It peaked in 1993 in France; the protein crop area had twin peaks in 1993 and 2001 in the UK; and the area peak was in 1998 in Germany. For Spain, however, with much lower yields for both field peas and wheat, the area under protein crops peaked in 2005.

The simulation is meant to be indicative, rather than precise, in view of the wide variations in the basic data on which the analysis is based. However, the conclusions remain broadly valid if one applies an assumption that direct production costs per hectare rise as yields increase, applying the average (statistically insignificant) coefficients listed in Section 4.1 above.

It would appear from the diagram that the evolution of field pea areas within the EU, and within individual MS, has been a reflection of the gradually worsening economics of field pea production vis-à-vis the main alternative crop, common wheat. The deterioration in the economics of field pea production affected high yielding regions first, but also hit low yielding areas from 2003. The removal of the special aids after 2012 would, *ceteris paribus*, make the competitive position of field pea production for feed markets, rather than for premium food uses, even worse.

4.4. The experience of Canada

The experience of Canada, the world's largest field pea producing nation, is very different from that of the European producers. In order to understand why the outcome was so different, the same basic model of production costs and comparative margins (taking full account of the benefits from nitrogen-fixation and yield increases for following crops) was applied to the Canadian situation, incorporating Canadian average yields for field pea and wheat crops, as well as Canadian producer prices. The results are depicted in Diagram EQ3.2.

Field pea yields and wheat yields are much closer to one another in Canada than they are in Europe. Typically the latter are only 20% higher than the former in Canada.

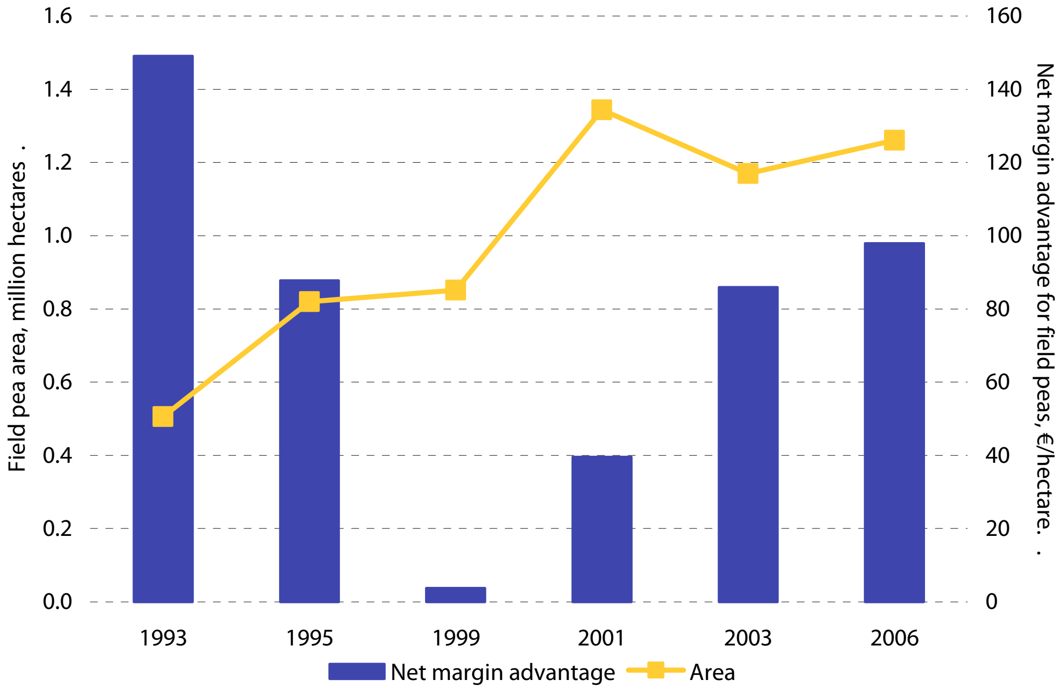
Applying world market prices (represented in this case by Canadian producer prices for these crops), one discovers that protein crops consistently generated higher gross margins per hectare than wheat in Canada. While this was happening, the areas under field peas expanded considerably after 1993, more than doubling from 1993 to 2001-2006.

A special feature of Canadian agriculture in the Prairie provinces, which are the main protein crop producing regions, is that the severe winter weather forces producers to rely upon spring plantings. Therefore, protein crops compete with spring wheat and rapeseed, whose yields are lower than those expected if the weather had been mild enough to permit winter plantings. A further feature of Canadian agriculture is that farming is more extensive than that typical in the EU, with lower inputs per hectare and lower yields, but larger farms.

These conditions do not apply in Europe. Therefore, climatic factors may explain why the clear comparative advantage in the EU now appears to lie in cereal production over the production of protein crops. In Canada, by contrast, the comparative advantage appears to lie in protein crop production.

However, there is one lesson from the Canadian experience that may have relevance to the EU situation. This is a focus upon the production of a high quality crop, able to satisfy food requirements in Asia. In this respect, the Canadian experience may be an indication of the future patterns of EU protein crop production after 2012 after special aids for such crops are ended. We may observe EU protein crop farmers concentrating increasingly upon premium food uses, relegating feed outlets to a role as a backstop, if and when food markets, notably outside the EU (in South Asia for field peas and Egypt for field beans), are limited.

Diagram EQ3.2: The advantage of field peas over wheat in terms of net margins (€/ha.) vs. the area under field peas in Canada, 1993-2006



Sources: Stat Canada; Saskatchewan Department of Agriculture

5. The appropriateness of protein crops for end-users

Interviews with feed companies revealed that protein crops are no longer viewed as a vital ingredient in bulk feed formulations. The discussion of EQ2 revealed that the use of protein crops in EU-27 protein feed ingredients declined considerably from 2001 to 2008. Four main reasons were cited by users for this sharp reduction in protein crop use in feed.

- The banning from most feeds of meat and bone meal from 2001, which removed a high protein ingredient that was valued as a complement to protein crops, which have relatively low protein contents.
- Second, rapeseed meal has become more plentiful as a by-product of biodiesel output.
- Third, soybean meal ("the gold standard for protein feed" according to one user, with a protein content over double that of field peas) was readily available.

- Fourth, CAP reforms in the 1990s had made cereals more competitive in feed uses[50]. This effect had been felt primarily before the evaluation period for this report, but compounders stated in interviews that the plentiful availability of relatively cheaper cereals made them more willing to replace protein crops in their mixtures. Econometric analysis of field pea prices in EQ2 revealed that a 2:1 feed wheat-soybean meal blend (popular as a blend in practice) is very accurate in describing the determinants of field pea prices in the major poultry-rearing region of France.

There are three respects in which protein crops have had some success in maintaining or developing markets. One is in on-farm feed. In Poland, where protein crops receive no coupled payments, livestock producers have maintained or expanded their sweet lupin areas (including in mixtures with cereals) for on-farm use.

Another relative success is in organic farming. Germany has seen organic protein crop output reach as much as 40% of local output, mainly for on-farm feed. However, it must be stressed that this success is only relative. Its organic output volumes have been falling since the 2003 reform, but more slowly than conventional production. Elsewhere, notably in France, organic output (little over 2% of the total) has recently lost market share.

The third comparative success is in uses outside the bulk feed sector, for human use, mainly in export markets, and pet food, including horse and bird feed. These users pay premium prices for higher quality supplies. The non-feed share of EU-27 field pea output has risen since 2003.

The discussion in EQ2 analysed the premia earned on yellow and green field pea exports from Canada (the main exporter) over the prices paid for feed peas in export markets. This demonstrated that the prices paid for food grade peas are very sensitive to South Asian import requirements, which vary considerably from year to year. The Canadian price data, which are much more comprehensive than those available for protein crops in the EU, are a valid proxy for prices in the EU, since the EU is a regular importer of feed grade peas from Canada and competes directly with Canada in the premium export market.

6. Effects of the 2003 reform on the market orientation of protein crops

The review of protein crop price data in EQ1 and EQ2 revealed the market orientation of protein crops, in terms of the close link between domestic prices and those in the export market. The differential between import unit values into the EU market and Canadian prices is consistent with the costs of freight from Saskatchewan to the main EU ports; and the differentials in prices within the EU market, for all three protein crops, are in line with the relativities that would be expected in an efficient free market, with minimal trade barriers.

The most volatile differentials are those for premium food grades of field peas and beans. This reflects the behaviour of world market prices, analysed in the Canadian case study appendix.

7. Investments in variety development

The number of seed companies undertaking "serious research"[51] into new protein crop varieties, where this term was employed to differentiate these companies from those with

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[50] The increased use of cereals in feed after the CAP reforms in the 1990s and the significance of reductions in cereals intervention prices in promoting the greater use of cereals in this end-use were described in the *Evaluation in the Common Market Organisation in the Cereal Sector*, October 2005

[51] *Protein crop production in the EU: a plant breeder's perspective*, F. Curtis, Nickerson Seeds, COPA-COGECA, Brussels, March 2008

minor research programmes, has declined appreciably. Interviews with German seed producers revealed a consensus that the size of that particular national market (where an estimated 50,000 hectares of protein crops were sown with certified seed) can no longer support the three companies currently involved in protein crop seed research programmes.

In the UK, another large protein crop producer, certified protein crop sales (16,000 tonnes in total nationwide) now represent a mere 5% of total certified seed sales by the main local supplier specialising in the sector.

In France, in 2006 certified protein crop seed sales were 33,000 tonnes. This was half their volume just ten years earlier, and this volume was divided 80%-17%-3% between field peas, field beans and sweet lupins[52]. The value of this entire segment was a mere 0.8% of the total French seed market.

Producers who retain seed for their own use accentuate the problem facing seed companies. The contraction in the output of protein crops and in the market for seeds has drastically cut the number of breeding programmes in the sector (including other grain legumes) from 49 in 2004 to only 17 in 2007, and of these, only five of the breeding programmes were considered to be significant[53].

Seed companies have developed field bean varieties that remained erect before harvesting, which is one reason why field bean areas have been falling less sharply than field pea areas and field bean yield trends are stronger than those for field peas. Producers in several MS stated that the development of erect varieties of field peas would revive their interest in the crop and the same is true of more resilient varieties that may be planted in winter. Some seed companies have recently launched more erect field pea varieties, but farmers appear cautious about adopting new varieties until they are proven.

A constraint facing seed producers is that it takes at least ten years to develop and commercialise new varieties and the shrinking market and cut-backs in research programmes are reducing the pace of introduction of new varieties.

In France, a particular request from producers is the development of varieties resistant to *aphanomyces*. The example of *aphanomyces* illustrates another respect in which the scale of the protein crop sector is now becoming too small to sustain R&D. This is in the development of chemicals to control pests and diseases.

The sector is finding it difficult to attract chemical companies to make the investments needed to develop treatments for *aphanomyces*, which has been known about for over 20 years, but is proving particularly difficult to control by chemical means. At present, the introduction of much longer periods between planting field peas on the same field is the only solution, contributing to the decline in French areas.

These factors are reflected in comments made in interviews by seed producers and agri-chemical companies. They now consider the potential outlet for their findings/products in the protein crop sector too small to justify a large investment in more R&D, when the major arable crops offer so much larger potential markets for successful discoveries, without the sense of longer term decline than now pervades the cultivation of protein crops for feed.

[52] *La filière protéagineuse, quels défis?* Edited by Guéguen & Duc, 2008
[53] *Protein crop production in the EU: a plant breeder's perspective*, op. cit.

8. Conclusions

The questions posed at the start of EQ3 are repeated below:

To what extent have the CAP measures applicable to the protein crop sector contributed to fostering the competitiveness and promoted the market orientation of protein crop production?

The relative competitiveness of protein crop production vs. alternatives will be analysed before 2004; after 2004; and with full decoupling, including associated production responses.

The effects of the 2003 reform on the competitiveness of protein crops. Analysis of incomes from protein crops and competing COP crops reveals that field peas and field beans have been less remunerative than the alternatives in most regions considered in recent years, including rotational benefits. In the riskiness of their returns, too, the two protein crops perform worse than other COP crops, apart from rapeseed. For an EU-15 protein crop producer whose reference yields were the weighted average of the reference yields of EU-15 producers as a whole, the protein crop measures introduced in the 2003 reform would, *ceteris paribus* (holding crop prices, direct costs and yields unaltered), have caused no change in the producer's income per hectare advantage for protein crops vs. other COP crops.

This is because the uniform special aid of €55.57 per hectare introduced from 2004 was stated to have been calculated as the average value in EU-15 protein crop producing regions of the difference between arable aids on protein crops and those on "other cereals".

However, retaining the *ceteris paribus* assumptions, the reform would have been expected to have had an effect on the competitiveness of protein crops in different regions. The uniform payment per hectare replaced the previous measures that made higher coupled payments on protein crops vis-à-vis other COP crops in regions with above average reference yields and lower coupled payments in low yielding areas. Thus, the reform reduced the net advantage over other COP crops in the coupled payments for producers in high yielding regions and increased the net advantage of protein crops to producers in low yielding regions.

Table EQ3.21: The change in coupled aids in EU-15 MS on protein crops vs. those on other COP crops following the 2003 protein crop measures (€ per hectare)

	Reference yields	Coupled aid advantage for protein crops		
	tonnes/hectare	2000-2003	After 2004	Change from 2004
Belgium-Lux	6.24	59.28	55.57	-3.71
Denmark	5.22	49.59	55.57	5.98
Germany	5.66	53.77	55.57	1.80
Greece	3.39	32.21	55.57	23.37
Spain	2.90	27.55	55.57	28.02
France	6.02	57.19	55.57	-1.62
Ireland	6.24	59.28	55.57	-3.71
Italy	3.90	37.05	55.57	18.52
Netherlands	6.66	63.27	55.57	-7.70
Austria	5.27	50.07	55.57	5.51
Portugal	2.90	27.55	55.57	28.02
Finland	2.82	26.79	55.57	28.78
Sweden	4.02	38.19	55.57	17.38
UK	5.83	55.39	55.57	0.19

Source: DG Agri

The net effect of the 2003 protein crop measures on producers in different EU-15 MS is described in Table EQ3.21. it reveals that in only six of the EU-15 MS was the net effect of the reform in excess of €10 per hectare, but these were all MS with low yields. They included Spain, which benefited from a net gain of over €28 per hectare, which was a very significant sum (representing over 85% of the total) in relation to the net advantage of €32 per hectare for field peas over other COP crops in 2006-2007, as described in Table EQ3.15.

For other leading protein crop producing MS, changes in other aspects of the market were much more significant in determining the changes in protein crop production. Price movements in alternative crops were one factor; the ban on meat and bone meal in most feed applications was another, reducing the appeal of protein crops to feed compounders; the expansion in rapeseed meal availability in the EU market was a further important demand factor; and the *aphanomyces* fungus affecting field peas was a serious issue in France.

Together, these influences, none of them part of the specific 2003 measures introduced in the protein crop sector, created a vicious circle, in which the declines in output fed on themselves. Traders and feed companies found the unit costs of handling smaller volumes of protein crops rising; while seed and chemical companies reduced research in the sector, which may be expected to have lasting effects upon the agronomic competitiveness of the protein crops.

<u>Simulations of the impact of full decoupling</u> Using producer questionnaires in six MS as a guide, indicate that the 2008/09 protein crop area would have been reduced by 8.6%, and output would have fallen by 219,000 tonnes in the event of full decoupling. It is important to note, however, that great care should be taken when interpreting these results in view of the limited, and possibly unrepresentative, sample on which this result is based.

Econometric analyses of the relationship between coupled aids and the areas under protein crops under two alternative assumptions regarding the quantification of rotational benefits from protein crops are not statistically significant, but would imply production reductions of 115,000 tonnes or 62,000 tonnes in total production following full decoupling.

<u>Effects of the 2003 reform on the market orientation of protein crops</u>. Protein crops are strongly market oriented; the virtual absence of trade barriers ensures that domestic protein crop prices are aligned with world market prices. World market price dynamics changed after 2004, but the 2003 protein crop measures had no effect at all on their market orientation.

Evaluation Question 4: Maintaining incomes

To what extent have the CAP measures applicable to the protein crop sector contributed to maintaining/increasing farmers' incomes?

The answer to this question will draw upon two main sources of data. The first is analysis of FADN data regarding the regional coupled and decoupled payments of protein crop producers on their protein crop areas, as well as on their areas under other COP crops. The other is national and regional data on nominal crop production costs and revenues, which were put into a consistent basis in the case study monographs and analysed in detail in the preceding discussion of EQ3. A possible weakness in this approach is that data on coupled and decoupled payments are derived from the FADN data, whose regional coverage is broader in some cases than that of the case studies. It has been assumed that regional coupled and decoupled payments per hectare for protein crop producers in the FADN database are exactly the same as those paid per hectare in the case study areas that lie within the relevant FADN region.

An issue of importance regarding the interpretation of the analysis of producer incomes is that they are determined per hectare, and not per holding, since that is the form in which the data are expressed. In the absence of sufficiently large FADN samples to permit estimates to be made of changes in the structure of holdings producing protein crops in each case study region, it is not possible to derive reliable estimates of incomes per holding over time.

The answer first draws upon the answer to EQ3 to assess how producers' full incomes per hectare (applying the definitions of income introduced in EQ3) have evolved from before the 2003 reform to the subsequent period, comparing protein crops with other COP crops, and identifying the share of full incomes that is received as coupled and decoupled payments.

It then compares the importance of coupled and decoupled payments in producer incomes in protein crop production and in the production of other COP crops in different regions.

1. Indicators and evaluation tools:

The judgement criteria, indicators and data sources are summarised in the following table.

Table EQ4.1: Judgement criteria, indicators and data sources regarding farmers' incomes

Judgement Criteria	Indicators	Data Sources
Changes in income per hectare, including both coupled and decoupled payments, on (a) protein crops alone, (b) alternative COP crops, (c) over full rotation cycles including protein crops	Time series of income from MS selected for case studies	National and regional government and academic institutions Case study interviews Producer questionnaires FADN
The importance of coupled payments in the overall rankings of income of producers of protein crops and other COP crops.	Income computed over the full cycle of alternative rotations	National and regional government and academic institutions Case study interviews Producer questionnaires
The proportion of coupled and decoupled payments in producers' incomes from protein crops and alternative COP crops	Division of incomes into market sales, decoupled and coupled payments Importance of coupled aid in the income of protein crop producers in different regions	National and regional government and academic institutions Case study interviews Producer questionnaires FADN

2. Effects of the 2003 measures on the incomes of protein crop farmers

In this section, we analyse the impact of the 2003 measures upon the incomes of protein crop producers. The definition of incomes that is employed is specifically adapted to reflect the externalities, in the form of rotational benefits that protein crops provide. It is

Full income per hectare = Gross margin per hectare at market prices + coupled aids per hectare + rotational benefits + decoupled aids per hectare.

These terms are applied as defined in EQ3. The methodology to determine gross margins at market prices and to quantify rotational benefits is also described in that section.

The way in which the coupled and decoupled aids per hectare are computed is as follows:

Data on the total areas in hectares under protein crops (denoted by PC.ha) and under other COP crops (Other COP.ha) are obtained by region from the FADN database for all COP specialist producers with >0 hectares of protein crops.

The same database provides information about the total coupled payments on protein crop areas (PC.coup) and those on other COP crop areas (Other COP.coup) for the same sample of producers.

Finally, information is obtained about the total decoupled payments made to the same group of producers (Decoup), without distinction between protein crop and other COP crop areas.

- The coupled aid per hectare on protein crops = (PC.coup)/(PC.ha)
- The coupled aid per hectare on other COP crops = (Other COP.coup)/(Other COP.ha)
- The decoupled aid per hectare, which is identical on protein crops and on other COP crops for each producer, = (Decoup)/(PC.ha + Other COP.ha).

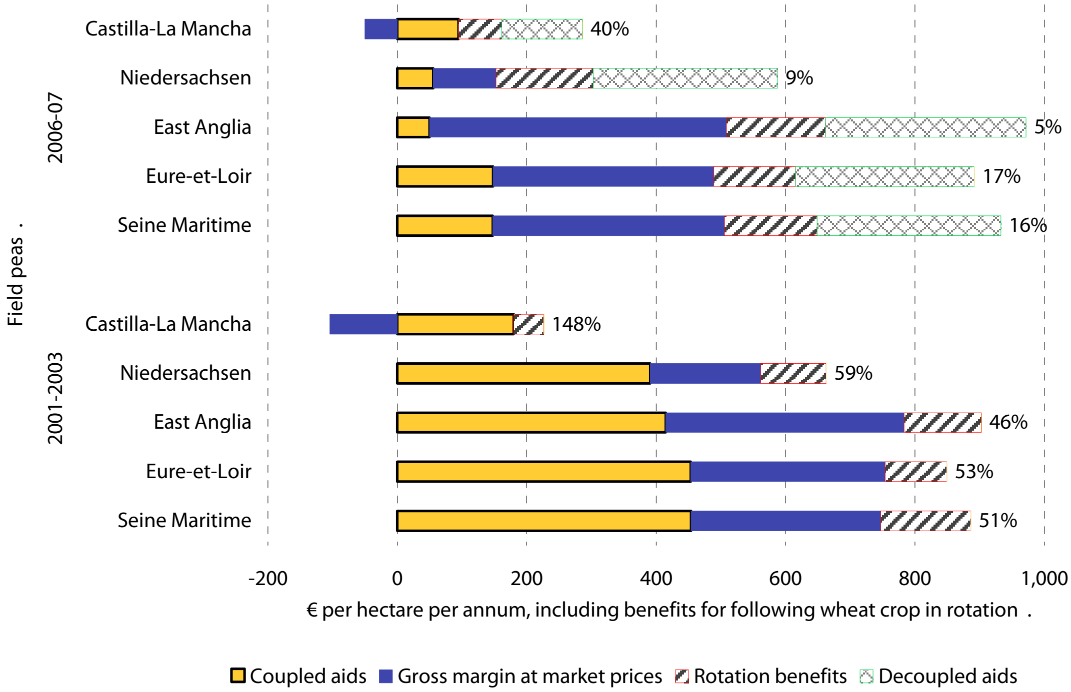
The absence of FADN and national margin data for Hungary and Poland prior to the reform has restricted the analysis to the five EU-15 regions included in the case study data.

2.1. Changes in the composition of full incomes for protein and other COP crops

Table EQ4.2 provides a breakdown of producers' full incomes per hectare on field peas and field beans and on other COP crops in 2000-2003, before the 2003 reforms took effect, and in 2006-2007, once SPS had been applied in all EU-15 MS. The full incomes for other COP crops represent the weighted averages (using the planted areas as the weights) of full incomes on cereal and oilseed crops in the individual regions.

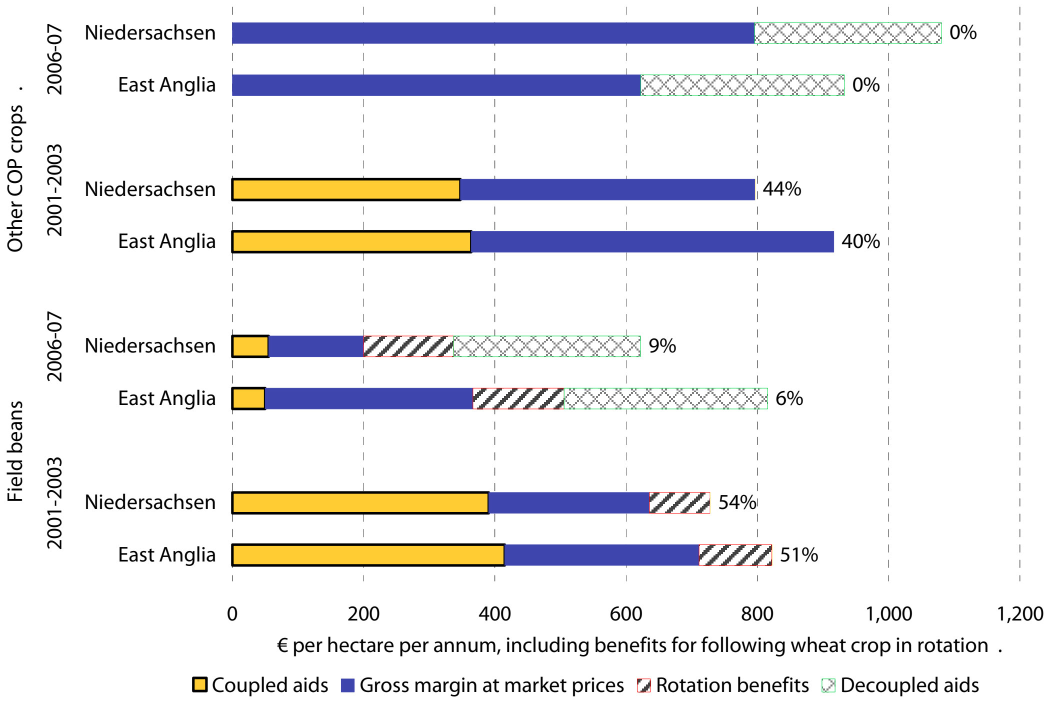
Diagram EQ4.1 contrasts the composition of full incomes from field peas in 2001-2003 and 2006-2007, highlighting changes in the sources of income. Because there are only two regions with data for field beans, there is sufficient space in Diagram EQ4.2 to compare full incomes from field beans with those from other COP crops in 2001-2003 and 2006-2007. In both diagrams, the percentages are the share of incomes derived from coupled payments.

Diagram EQ4.1: Comparison of breakdown of full incomes per hectare from field peas, 2001-2003 and 2006-2007 (€ per hectare and % share of income from coupled payments)



Sources: Derived from gross margin data analysed in EQ1 and EQ3 and FADN database
Note: The percentage figure represents the share of coupled aids in the full income.

Diagram EQ4.2: Breakdown of full incomes per hectare from field beans and other COP crops, 2000-2003 and 2006-2007 (€ per hectare and % share of income from coupled aids)



Sources: Derived from gross margin data analysed in EQ1 and EQ3 and FADN database
Note: The percentage figure represents the share of coupled aids in the full income

Table EQ4.2: Composition of full incomes per hectare from protein crops and other COP crops, 2001-2003 and 2006-2007 (€ per hectare)

		Field peas						Field beans	
		Seine Maritime	Eure-et-Loir	East Anglia	Niedersachsen	Castilla-La Mancha		East Anglia	Niedersachsen
2001-2003	Coupled aids	454	454	415	391	180		415	391
	Rotation benefits	139	95	119	101	46		111	93
	Gross margin at market prices	293	301	368	171	-104		296	245
	Decoupled aids	0	0	0	0	0		0	0
	Full income	**886**	**849**	**903**	**663**	**122**		**822**	**728**
	% from coupled aids	***51.2%***	***53.4%***	***46.0%***	***59.0%***	***148.2%***		***50.5%***	***53.7%***
2006-2007	Coupled aids	148	148	50	56	95		50	56
	Rotation benefits	143	126	153	150	67		140	137
	Gross margin at market prices	358	341	459	97	-50		316	145
	Decoupled aids	284	277	310	285	125		310	285
	Full income	**933**	**892**	**972**	**588**	**236**		**816**	**622**
	% from coupled aids	***15.8%***	***16.6%***	***5.1%***	***9.5%***	***40.0%***		***6.1%***	***8.9%***
		Other COP crops							
		Seine Maritime	Eure-et-Loir	East Anglia	Niedersachsen	Castilla-La Mancha			
2001-2003	Coupled aids	395	371	364	347	157			
	Rotation benefits	14	11	10	6	2			
	Gross margin at market prices	590	406	552	449	25			
	Decoupled aids	0	0	0	0	0			
	Full income	**998**	**788**	**926**	**802**	**185**			
	% from coupled aids	***39.6%***	***45.2%***	***39.2%***	***43.2%***	***77.1%***			
2006-2007	Coupled aids	94	89	0	0	39			
	Rotation benefits	16	16	13	13	3			
	Gross margin at market prices	663	492	623	796	21			
	Decoupled aids	284	277	310	285	125			
	Full income	**1,057**	**875**	**946**	**1,094**	**187**			
	% from coupled aids	***8.9%***	***7.5%***	***0.0%***	***0.0%***	***18.3%***			

Sources: Derived from gross margin data analysed in EQ1 and EQ3 and FADN database

Note: The percentage figure represents the share of coupled aids in the overall incomer. In several regions, data are not available for all the years listed but have been estimated as explained above.

- We observe that full incomes per hectare on protein crops fell between 2000-2003 and 2006-2007 in three of the seven region/protein crop combinations included in Table EQ4. 2; they were Niedersachsen, where they fell for both for field peas and field beans, and East Anglia, where they fell for field beans alone.

- Full incomes per hectare rose in Seine Maritime, Eure-et-Loir, East Anglia and in Castilla-La Mancha in field pea production.

- In all cases, full incomes per hectare of other COP crops rose between the two periods.

The mixed outcomes observed in the changes recorded in the full incomes earned per hectare of protein crops occurred in spite of a significant increase (as a result of higher cereal prices) in the credit attributed to the benefits of rotation in the following common wheat crop. These credits totalled between €125 and 150 per hectare in 2006-2007 in all regions, apart from Castilla-La Mancha, where common wheat yields, and hence the benefits from yield increases of close to 10%, are lower than in the other regions included in the table.

2.2. Coupled payments in full incomes from protein and other COP crops

In this section, we analyse the data presented in Table EQ4.2 regarding the proportions of full incomes per hectare derived from coupled payments on protein and other COP crops.

2.2.1. 2001-2003

- Before 2004, the coupled aids represented 50-60% of the full income per hectare of protein crops in all regions except East Anglia/field peas, where the figure was 46%., and Castilla-La Mancha/field peas, where the gross margin at market prices in 2000-2003 was actually negative, and so coupled aids accounted for 148% of full income.

- The dependence upon coupled aids was somewhat lower for the other COP crops before 2004 (Table EQ4.2). For the four regions outside Spain, coupled aids contributed 39-46% of COP crop full incomes in 2000-2003. For Castilla-La Mancha, coupled aids represented 77% of full income for these crops.

2.2.2. 2006-2007

In 2006-2007, the contribution of coupled aids in producers' full incomes was much smaller.

- In Castilla-La Mancha/field peas, their share of full income fell to 77% (for other COP crops in the same region, coupled payments supplied 18% of full income as shown in Table EQ4.2). Decoupled aids made up for much of the decline in coupled payments, providing 40% (€95 out of €236 per hectare) of the full income.

- In the other four regions, the reform reduced coupled aids to between 5% and 17% of total protein crop income. The highest percentages were in regions of France where, as happened in Spain, 25% of the former arable aids remained coupled after 2006.

- Among the other COP crops, coupled aids fell to zero in Germany and the UK after 2004, but the partial coupling retained in France left a modest proportion of income (7-9%) still coupled on these cereal and oilseed crops (Table EQ4.2). In Castilla-La-Mancha, this proportion was higher at 18%.

2.3. The proportion of coupled and decoupled payments in producer incomes

This section assesses the impact of the 2003 measures on coupled and decoupled payments as a share of full income per hectare on protein crops and other COP crops. Data are those presented in Table EQ4.2, as well as the corresponding data for 2004-2005.

Table EQ4.3 contrasts total full incomes per hectare (defined as gross margins *plus* rotational externalities *plus* coupled and decoupled payments) for 2001-2003, i.e., prior to the new CAP protein crop measures, immediately after the reform (2004-2005) and in the subsequent period (2006-2007). The period after the 2003 reform is broken into two, in order to reveal the position after the full application of the SPS in all EU-15 MS, which occurred in 2006.

Table EQ4.3: Comparison of total incomes and the share of coupled and decoupled payments, 2001-2007, for protein crops and other COP crops (€ per hectare)

	2001-2003			2004-2005			2006-2007		
	Total income	*Coupled %*	*Decoupled %*	Total income	*Coupled %*	*Decoupled %*	Total income	*Coupled %*	*Decoupled %*
Field peas									
Seine Maritime	886	*51.2%*	*0.0%*	731	*52.7%*	*0.0%*	933	*15.8%*	*30.4%*
Eure-et-Loir	849	*53.4%*	*0.0%*	780	*46.7%*	*0.0%*	892	*16.6%*	*31.0%*
East Anglia	903	*46.0%*	*0.0%*	921	*19.0%*	*16.1%*	972	*5.1%*	*31.9%*
Niedersachsen	663	*59.0%*	*0.0%*	603	*28.8%*	*22.0%*	588	*9.5%*	*48.5%*
Castilla-La Mancha	122	*148.2%*	*0.0%*	183	*86.0%*	*0.0%*	236	*40.0%*	*52.9%*
Field beans									
East Anglia	822	*50.5%*	*0.0%*	749	*30.3%*	*19.8%*	816	*6.1%*	*38.0%*
Niedersachsen	728	*53.7%*	*0.0%*	628	*36.2%*	*21.1%*	622	*8.9%*	*45.8%*
Other COP crops									
Seine Maritime	998	*39.6%*	*0.0%*	800	*48.1%*	*0.0%*	1,057	*8.9%*	*26.8%*
Eure-et-Loir	788	*47.0%*	*0.0%*	779	*46.8%*	*0.0%*	875	*10.2%*	*31.6%*
East Anglia	926	*39.3%*	*0.0%*	741	*23.6%*	*20.0%*	946	*0.0%*	*32.8%*
Niedersachsen	802	*43.3%*	*0.0%*	706	*24.6%*	*18.7%*	1,094	*0.0%*	*26.0%*
Castilla-La Mancha	185	*85.3%*	*0.0%*	261	*60.5%*	*0.0%*	187	*20.8%*	*66.7%*

Source: Derived from data analysed in Table EQ4.2, the FADN database and case study monographs

Table EQ4.2 reveals that the combined level of coupled and decoupled aids fell in six out of the seven combinations of regions/protein crops between 2001-2003 and 2006-2007. Castilla-La Mancha was the exception, where total aids per hectare of field peas rose from €180 to €220. Total support per hectare fell in the same six out of seven combinations of regions/other COP crops, with Castilla-La Mancha again the sole exception.

When total coupled and decoupled aids to protein crop farmers are expressed as a share of income, as is done in Table EQ4.3, the analysis reveals that it fell between 2001-2003 and 2006-2007 in all regions, apart from Niedersachsen for field beans, where it rose slightly. For other COP crops, Castilla-La Mancha was the only region where the share of total aid in farmers' income was higher in 2006-2007 than it had been in 2001-2003. The tables also highlight the shift in income supports from coupled to decoupled payments.

In the analysis prepared for EQ1, it was hypothesised that, by applying a fixed coupled aid per hectare of €55.57 on protein crops, the 2003 reform should have raised the combined value of coupled and decoupled payments per hectare of protein crops in regions with low reference yields, and reduced the combined value in regions with above-average reference yields, assuming that the decoupled SPS payments were calculated so as to convert into a decoupled form a sum equal to the decline in coupled aids after the 2003 measures were applied.

This hypothesis is consistent with the data in Table EQ4.3. Castilla-La Mancha is the sole region among the case study regions with a reference yield significantly below the average for EU-15 protein crop producing regions (its reference yield was 2.90 tonnes per hectare, as against the EU-15 average of 5.85, deduced from the determination of the €55.57 special aid). It enjoyed an increase in combined coupled and decoupled aids per hectare on field peas of €40 per hectare after the full implementation of the 2003 reform, including the SPS system, in 2006.

3. Conclusions

The questions posed at the start of EQ4 are repeated below:

To what extent have the CAP measures applicable to the protein crop sector contributed to maintaining/increasing farmers' incomes?

The effects of the 2003 reform on the income of protein crop producers. The 2003 CAP measures had a potential impact upon all four components of full incomes per hectare: gross margins at market prices; rotational benefits; coupled aids; and decoupled aids.

Gross margins at market prices depend upon movements in prices, yields and direct costs. Prices of protein crops were unaffected by the 2003 CAP measures, since import tariffs on protein crops are minimal. Yields are determined by factors that were unaffected by the 2003 measures. Direct costs, too, were not affected by the 2003 reform. Therefore, we conclude that gross margins at market prices were not affected by the CAP measures.

Rotational benefits depend upon yields and prices of the cereal crop following protein crops in a rotation. Neither of these variables was affected in any way by the CAP measures in the protein crop sector.

Coupled aids were reduced in value per hectare as a major objective of the overall 2003 CAP reform. In the case of the protein crop measures, as explained earlier, the adoption of a uniform coupled aid per hectare caused coupled aids per hectare to be moved slightly away from higher yielding regions towards lower yielding areas.

The decoupled aids are a key element of the broad CAP reform, and were not specific to the protein crop sector. However, they need to be taken in conjunction with the coupled aids to determine the overall impact of the combined CAP measures in the protein crop sector. We observe that the combined value per hectare of these aids moved in the way described in the preceding section. Only in the lowest yielding region in our sample (Castilla-La Mancha) did the combined value of the coupled and decoupled aids increase for protein crops between 2001-2003, immediately prior to the implementation of the 2003 protein crop measures, and 2006-2007, after the reform; in the other regions, the combined value fell.

The measures, therefore, had a minor net effect on protein crop producers' full incomes per hectare, providing a slight net boost in low yielding regions and a slight net reduction in high yielding areas. However, much more important in terms of changes in producers' full incomes after the reform were the changes in gross margins at market prices. These were favourable in three of the four regions studied (the exception was Niedersachsen, for both field peas and beans), and the increases that occurred in every region in the value of the rotational benefits. Neither of these variables was affected by the 2003 protein crop measures.

As a result of these factors, full incomes per hectare on protein crops rose between 2001-2003 and 2006-2007 in four of the region/crop combinations that were analysed (Seine Maritime, Eure et Loir, East Anglia and Castilla-La Mancha, all for field peas). Full incomes per hectare fell significantly between these same two periods on both field peas and beans in Niedersachsen, principally because local gross margins at market prices deteriorated. Full income fell €6 per hectare on East Anglian field beans between 2001-2003 and 2006-2007, but this was entirely due to a reduction in combined coupled and decoupled aids that was larger than this.

On balance, we conclude that the 2003 protein crop measures were a factor that helped to stabilise, and hence maintain, protein crop producers' incomes per hectare.

It is not possible to make a statement about the effects in terms of total incomes per holding, since data are not available about changes in the size of a typical protein crop farm.

Chapter 7: Answers to Theme 4 Questions: Efficiency, Coherence and Relevance

Evaluation Question 5: Efficiency of the CAP measures

To what extent are the CAP measures applicable to the protein crop sector after the 2003 reform efficient in achieving the objectives of these measures?

Efficiency in this context will be defined in budgetary terms (using cost-benefit analysis) and in administrative terms, the latter by assessing the cost (both in administrative budgets and in resources, such as staff time) of implementing the measures. These administrative costs relate both to producers, when applying for coupled aids for protein crops, and to the government agencies responsible for administering the disbursement of these coupled payments.

It is necessary also to assess whether the measures have achieved the objectives of the reform; therefore, reference will be made to the discussion of the previous Evaluation Questions to determine whether efficiency has been achieved in the application of the measures. This will include consideration of the deadweight, if any, associated with the measures and unintended consequences of the measures.

The answer to this question is based upon three principal sources of data. One is information from DG Agri regarding the budgetary costs of CAP measures directed towards protein crops. The second is the answers to previous Evaluation Questions, which describe the response of producers and users to the 2003 reform. The third source is interviews with government payment agencies and producers, and analysis undertaken for the case study monographs.

1. Indicators and evaluation tools:

The judgement criteria, indicators and data sources relevant for this question are summarised in the following table.

Table EQ5.1: Judgement criteria, indicators and data sources regarding efficiency of the measures

Judgement Criteria	Indicators	Data Sources
The extent to which the objectives of enhanced agricultural competitiveness and the stabilisation of producer income were achieved with a reasonable use of resources	The relationship between the budget allocated to these measures and their results and effects (cost-benefit analysis), taking account of the value of the protein crop market	Producer interviews Budgetary data Answers to previous EQs
	Conclusions from EQ1-EQ4 (Impacts of the measures on the production of protein crops, on the supply to the processing industry, on the profitability and price dynamics of the sector and on producers' income)	The sources listed in connection with EQ1-EQ4
Deadweight	Determining whether the changes in protein crop output would have arisen even if coupled payments had not been made (drawing upon EQ3, in particular)	Analysis in EQ3
Unintended side-effects	The extent to which uniform special aid per hectare favoured output in low yielding areas at the expense of high yielding regions	National and regional sources Producer interviews

Simplification of the administration of the measures: (a) from the perspective of producers	The administrative cost (financial and in staff time) of producers in implementing the CAP measures	National and regional sources Producer interviews
Simplification of the administration of the measures: (b) from the perspective of government agencies administering the measures	The administrative cost (financial and in staff time) of official agencies in implementing the CAP measures	Producer interviews
	Opinions of the relevant representatives of the administrative structures involved	Interviews with official agencies (at a Community, national and regional level)

2. Costs of the measures and the achievement of CAP objectives

Table EQ5.2 describes the evolution of the budget for coupled measures for protein crops since 2000. The budget is contrasted with the total output of protein crops in receipt of coupled payments. The value of output is calculated by applying annual French market prices for field peas, field beans and sweet lupins, since price data from other MS are sparse.

We observe that, prior to the adoption of a uniform €55.57 per hectare coupled payment for protein crops, the budgetary cost of the measures averaged close to €500 million per annum. Following the reform, the annual costs of coupled payments to the budget fell steadily, to stand at €43 million in 2008. At the same time, the costs of decoupled payments rose.

The outlay per tonne of protein crops, which was in the region of €120 prior to 2005, fell by roughly €100 from 2005 onwards. As a proportion of the value of protein crop output, the budgetary expenditures declined from a peak of 98.3% in 2004 to a low of 10.2% in 2008. This decline reflected the major shift to decoupled payments as an objective of the 2003 reform.

Table EQ5.2: Budgetary costs of protein crop measures vs. the value of output (€ million)

	Production	Value of output	Budgetary expenditure	Budgetary outlay/tonne	Budget as % of value
	'000 tonnes	€ million	€ million	€/tonne	of output
2000	3,843	542	524	136	96.8%
2001	4,026	578	450	112	77.7%
2002	4,105	559	515	125	92.1%
2003	4,036	639	474	117	74.1%
2004	4,277	516	507	118	98.3%
2005	3,712	442	71	19	16.0%
2006	3,189	461	65	21	14.2%
2007	2,278	526	59	26	11.3%
2008	2,032	418	43	21	10.2%

Source: DG Agri, UNIP, FAO,

Note: The production refers solely to the MS in receipt of coupled aids, including CNDP schemes in new MS.

In assessing the success of the measures in achieving the objectives of the reform, we focus upon five measures of competitiveness. They are in terms of the sector's share of world output; in its net trade balance; in its share of the domestic market for protein feed ingredients. We also consider the success of the measures in keeping local prices aligned to world market values; and in maintaining profitability and stabilising producers' incomes.

2.1. Changes in the EU share of world production

Table EQ5.3 compares the EU-27 share of world output of the three protein crops, individually and combined, before the reform was implemented (2000-2003), immediately after the reform (2004-2005) and after the full implementation of the SPS in EU-15 MS (in 2006-2007).

EU output of the two major protein crops fell sharply between 2000-2003 and 2006-2007, while total world output of these crops (which includes the EU contribution) was stable. Only in sweet lupins, the least important protein crop (and one that is favoured for on-farm feed use), was EU output maintained, while world production tumbled by over 56%. In aggregate, EU protein crop production fell by 34.9% from 2000-2003 to 2006-2007, reducing its share of world output from 27.3% to 18.3%.

Table EQ5.3: EU share of world protein crop output, pre- and after 2004 ('000 tonnes)

		2000-2003	2004-2005	2006-2007	% change 2000-2003 to 2006-2007
Field peas	EU	3,089	2,809	1,769	-42.7%
	World Total	10,129	11,412	10,243	1.1%
	EU Share	30.5%	24.6%	17.3%	
Field beans	EU	4,269	4,300	2,945	-31.0%
	World Total	16,083	17,702	15,948	-0.8%
	EU Share	26.5%	24.3%	18.5%	
Sweet lupins	EU	161	173	178	10.5%
	World Total	1,308	1,321	574	-56.1%
	EU Share	12.3%	13.1%	30.9%	
Total protein crops	EU	7,519	7,282	4,891	-34.9%
	World Total	27,519	30,435	26,765	-2.7%
	EU Share	27.3%	23.9%	18.3%	

Source: FAO

2.2. Changes in the EU trade balance in protein crops

Table EQ5.4 lists total EU-27 imports and exports of protein crops. It also describes the changes in the shares of net imports in meeting domestic demand. Again, three periods are compared to see the full impact of the reform, 2000-2003, 2004-2005 and 2006-2007.

In foreign trade, where EU import tariffs are minimal (a 0% MFN tariff on field peas, 3.2% on field beans and 2.5% on sweet lupins), the Community enjoys a growing competitiveness in the field bean export market, both raising exports in absolute terms and switching the EU balance from one of modest net imports to one where there are significant net exports.

In field peas the EU remains a net importer, but there is a sizeable export volume, which consists predominantly of peas for food use and for pet food, which attract premium prices.

Sweet lupin imports have fallen, as has the share of domestic demand supplied from imports.

An important factor behind the decrease in imports for all three crops since 2000-2003 was the decline in total demand for protein crops, which was discussed in Chapter 4. That explains why, although imports of field peas had dropped by 17% between 2000-2003 and 2006-2007, net imports nearly trebled as a proportion of EU field pea demand.

Table EQ5.4: EU-27 trade balance in protein crops, 2000--2007 ('000 tonnes)

	2000-2003			2004-2005			2006-2007		
	Import	Export	Net imports /demand	Import	Export	Net imports /demand	Import	Export	Net imports /demand
Field peas	1,222	963	5.7%	1,759	758	26.5%	1,016	573	15.6%
Field beans	244	238	0.5%	187	300	-9.4%	130	355	-30.6%
Sweet lupins	325	47	46.7%	314	25	43.4%	249	9	25.3%

Source: COMEXT

2.3. Changes in the protein crop share of vegetable protein feed ingredients

The changing balance of EU demand for vegetable protein feed ingredients is described in Table EQ5.5. All quantities are expressed in terms of protein content. The major source of protein feed is soybean meal, which maintained a share of just under two thirds in the slowly expanding demand for protein ingredients. Rapeseed meal made the greatest gains, lifting its sales by approximately 60%, as a result of the increased processing of rapeseed for biofuels.

Protein crops lost a considerable share of their market, declining from 943,000 tonnes, protein content, in 2000-2003 to 604,000 tonnes in 2006-2007 for two reasons: one was the ban on the feed use of meat and bone meal in 2001, which removed a vital complement to protein crops in feed formulations; the other was the increased availability of alternative ingredients that were higher in their protein content, such as rapeseed meal and soybean meal.

Table EQ5.5: EU-27 demand for vegetable protein feed ingredients ('000 tonnes, protein)

	Meal			Field Peas	Field Beans	Sweet Lupins	Dry Fodder	Total Protein Ingredients
	Soybean	Rapeseed	Sunflower					
2000-2003	14,320	2,088	1,401	639	200	104	862	22,109
2004-2005	14,422	2,718	1,366	753	243	100	871	22,638
2006-2007	15,047	3,317	1,292	385	140	79	794	22,832

Source: Derived from detailed data in the discussion of EQ2

2.4. Changes in the price dynamics of the protein crop sector

Protein crop prices track world market prices closely. This was evident before the 2003 reform and did not change after the introduction of the 2003 measures. We conclude that the 2003 reform did not interfere with the price dynamics of the protein crop sector.

2.5. Stabilisation of producers' incomes and changes in the profitability of protein crop production

The analysis presented in EQ3 and EQ4 revealed that protein crops' competitiveness deteriorated vs. other COP crops after 2003. The 2003 protein crop measures, however, had little or no role in the worsening competitiveness.

The only case in which it was possible to detect some impact was in the relative position of lower and higher yielding regions. The adoption of a uniform coupled aid per hectare provided a modest boost in coupled payments per hectare vs. coupled payments on other COP crops in low yielding regions after the 2003 reform was implemented and a small deterioration in the relative situation regarding coupled payments in higher yielding regions.

As EQ4 described, the reform altered the supports for the protein crop sector. Coupled aid was reduced, while at the same time decoupled aid was introduced. However, as our preceding analysis revealed, the result of this change was to lower the overall level of coupled plus decoupled support per hectare between 2001-2003 and 2006-2007 in six out of the seven permutations of regions/protein crops covered in our analysis, the sole exception was the lowest yielding region in the sample, Castilla-La Mancha/field peas.

The conclusion drawn in EQ4 was that the combined measures introduced after 2003, namely the special aid and the SPS, continued to provide a stable and important share of protein crop producers' incomes after 2003, with little change in the total sum paid per hectare as income supports after the reform in relation to the level in 2001-2003.

3. Deadweight effects

Deadweight in CAP measures is assessed in terms of whether the intended objectives could have been achieved in the *absence* of the measures evaluated. Since the sector's area and output contracted considerably after the reform measures were introduced, deadweight is determined by examining whether the decline that occurred would have occurred anyway in the absence of the coupled aid. We therefore consider whether the coupled aid of €55.57 per hectare was necessary to achieve the same outcome as that which was observed in reality.

The decline that occurred in overall protein crop areas and outputs was not caused to any significant degree by the 2003 measures. The discussion in previous chapters indicated that the decline was due predominantly to external factors, ranging from the ban on the use of meat and bone meal in feed to the much larger supplies of rapeseed meal as a result of CAP energy crop measures, to crop disease (*aphanomyces*) and a deterioration in the competitive position of protein crops in terms of gross margins at market prices vs. other COP crops.

We now consider the potential effect of full decoupling on protein crop areas and output. The discussion in EQ3 considered this issue, applying three different methodologies: one was based upon the results of producer questionnaires; the other two used econometric analyses of the relationship between changes in protein crop areas and differences in incomes per hectare from field peas and other COP crops under two alternative methodologies regarding the quantification of the benefits from rotations including protein crops.

There are important reservations associated with conclusions drawn from the results from each of these three approaches. The producer questionnaires are drawn from a comparatively small sample of fewer than 120 producers, which are not necessarily representative of the population of protein crop farmers as a whole. The two econometric analyses, applying linear relationships, yield results that are not statistically significant. Therefore, little weight may be placed on deductions made from these three methodologies. Nevertheless, it is noteworthy that they all indicate that the loss of protein crop areas that would have occurred as a result of the removal of the coupled protein crop aids would have been small.

Examination of the producer questionnaires implies that the removal of the coupled payment entirely would reduce the protein crop area by 8.6% from its level in 2008/09, i.e., about 72.000 hectares (8.6% of 0.84 million hectares).

The econometric analyses under two different methodologies regarding the assessment of rotational benefits imply that the removal of coupled payments would lower the protein crop area by 44,000 hectares or 24,000 hectares, according to the methodology applied.

Under all three approaches, it would seem that supply is inelastic with respect to the coupled aid. On the basis of their results, the trade-off between EU budgetary expenditures and the preservation of protein crop areas is one that implies a substantial budgetary outlay, at the margin, to preserve each hectare of protein crops. In approximate terms, a budgetary cost of €46.7 million (0.84 million hectares x €55.57) was spent to keep between 24,000 and 72,000 hectares in protein crop production, in terms of these alternative approaches.

This translates into a budgetary outlay of €650 to $1,950 per annum for each hectare that is maintained in protein crops, a figure that is very high in terms of the benefit achieved. Thus, based on the analysis of the questionnaires and linear regression results, whose limitations are to be stressed, we can emphasise the inefficiency of the measures. Regarding deadweight in its strict sense, however, the analysis suggests that there was no deadweight in the measures, since the outcome would not have been exactly the same in the absence of all special aids.

4. Unintended effects

One of the observations made in the discussion of EQ1, in the context of analysis of the changes in the geographical distribution of production, was that the changing form of the coupled payments on protein crops, away from one that made higher coupled payments to regions with higher reference yields under national regionalisation plans towards a single uniform payment of €55.57 per hectare in all EU-15 MS, would have been expected to have encouraged an expansion in protein crop production in regions with a low reference yield, while discouraging production in regions with higher than average reference yields.

The discussion in previous chapters provides limited evidence that this did occur. However, it is not statistically significant. Furthermore, the magnitude of the redistribution of coupled aids between high and low yielding regions was typically small in relation to the overall full incomes per hectare when producers are comparing protein crops with other COP crops.

We conclude, therefore, that such an unintended consequence had only a minor effect on the outcome, and that the large changes that occurred in protein crop areas owed virtually nothing to this factor.

Under the Health Check reform, this particular unintended consequence of the measures as they apply to all EU-15 MS will be removed, since the €55.57 coupled payments will cease by 2012. However, individual MS enjoy discretion over the use of funds to retain an element of coupled aid under Article 68 measures[54] and to apply partial decoupling under Article 63[55].

5. Simplification of the administrative measures for producers

During case study interviews with individual producers and with their associations, questions were asked about the effect of the 2003 reform regarding the administrative burden that it placed upon producers.

In both Hungary and Poland, there are no specific coupled payments for protein crops. Therefore, the measures were not considered to entail any specific administrative burden upon producers in those MS. In France, Germany, Spain and the UK, when producers and representatives of their associations were asked direct answers about the administrative burden created by the special aids, the answers were all very similar. They unanimously viewed the main administrative burden associated with the implementation of the 2003 reform as those associated with the application of the SPS decoupled payments.

As regards protein crop specific aids, the universal view expressed by producers and their representatives was that they were familiar with the workings of the system of coupled payments and verification of their claims under the previous CAP measures. Therefore, the

[54] At present, MS may retain by sector 10% of their national budget ceilings for direct payments for use for environmental measures or improving the quality and marketing of products in that sector. Under the Health Check, the money will no longer have to be used in the same sector, and may be used to help vulnerable types of farming; and countries operating the Single Area Payment Scheme (SAPS) system will become eligible for the scheme. *(DG Agri, "The measures in a nutshell", November 2008.)*

[55] France, for example, has stated that it intends to transfer €40 million to protein crop supports by using the flexibility provided in Article 63 under the heading of sustainable development.

2003 reform itself caused them no extra administrative burden, and it was viewed as a trivial administrative task to submit separate area data for protein crops within their overall claims.

6. Simplification of administrative measures for government agencies

The response of government agencies to questions about the administrative burden imposed by measures applied solely to the protein crop sector was similar to that provided by producers. The view expressed in every interview was that this was a very minor element of the overall administration entailed by the CAP and the disbursement of coupled and decoupled payments to individual producers. As such, the additional administrative time and cost attributable to the protein crop measures alone was never identified as having independent weight in the workload of these agencies.

In two MS, we obtained reports that reviewed the costs of administering the CAP measures as a whole (no reports or estimates were available that separated out the protein crop measures from other CAP measures). In the UK, the National Audit Office[56] analysed the administrative time involved in processing payments for individual holdings prior to the 2003 reform and estimated that the average time per application for all payments, including those for protein crops, was 12 hours. The analysis has not been updated since then, but the opinion of government officials was that the major administrative costs imposed by the 2003 reform were those caused by the adoption of the SPS payments. In the first year of SPS, it was estimated by the National Audit Office that the administrative cost to the payments agency averaged around UK£750 (over €1,000 at the time) per claim.

In France, the Ministry of Agriculture and Fisheries published a report on the performance of Programme 227[57] . Under Objective 4, the report assessed the cost of administering the CAP measures belonging to the first pillar, including measures related to protein crops. This cost was expressed as a percentage of total aid received, and it is measured from the taxpayers' point of view (Table EQ5.6).

Total administrative costs combine the costs of all resources used to implement measures under the First Pillar of the CAP. These resources include the Ministry of Agriculture and Fisheries, the Single Paying Agency (AUP) and Boards such as ONIGC. Specific cost items are salaries, travel expenses and equipment costs borne by the Ministry and paying agencies. They do not include costs incurred by other departments or governmental offices involved in the negotiation of measures and the controls of the correct application of the measures (such as Customs offices). The table reveals that, over time, administrative costs have remained quite stable at around 2.8% of total CAP expenditure. No significant change can be detected in 2007 and 2008 from the years prior to the full implementation of the 2003 reform.

Table EQ5.6: France, cost of administering the first pillar CAP measures as a percentage of the CAP aid received

2005	2006	2007	2008	2008	2008	2009
Actual	Actual	Actual	Initial Forecast	Revised forecast	Actual	Target
2.68	2.81	2.79	2.89	2.84	2.7	less than 2.84

Source: Ministry of Agriculture and Fisheries, Single Paying Agency (AUP), France.

The component of the administrative costs attributable to protein crop coupled payments alone was said in interviews to be minuscule, and was not materially affected by the reform.

[56] National Audit Office, UK, *Arable Aid Payments Scheme,* 1999, and *A progress update in resolving the difficulties in administering the Single Payment Scheme in England*, 2009.
[57] *Valorisation des produits, orientation et régulation des marchés* in April 2009. Objective 4: « *Mettre en oeuvre les politiques communautaires (premier pilier) dans des conditions optimales de coût et de qualité de service*

7. Conclusions

The questions posed at the start of EQ5 are repeated below

To what extent are the CAP measures applicable to the protein crop sector after the 2003 reform efficient in achieving the objectives of these measures?

The extent to which the objectives of enhanced agricultural competitiveness and the stabilisation of producers' income were achieved with a reasonable use of resources.

In terms of the budgetary cost of the coupled measures for protein crops, the 2003 reform has been successful in lowering the financial burden for coupled payments to the CAP budget. At the same time, a different type of support to farmers' incomes was introduced in the form of decoupled aid. The case study analyses revealed that the combined coupled and decoupled payments per hectare for protein crop producers in the regions studied in France, Germany and the UK fell by comparatively small sums, in relation to the full income of producers, when contrasting 2006-2007 with 2001-2003. For Spain, there was an increase in the combined value of coupled and decoupled aids per hectare. The net effect was therefore, minor.

We conclude that, when comparing the effect of the measures after the reform with the situation immediately prior to its implementation, the reform maintained its role in stabilising the incomes of protein crop farmers.

The major factors behind the decline in protein crop production lay outside the protein crop sector, and cannot be attributed to the 2003 measures. Among these external factors were world market price movements and reduced competitiveness of protein crops in the feed sector. Other CAP measures were also a factor, e.g., CAP energy crop measures which encouraged the production of rapeseed for biofuels, which generated a large increase in the availability of rapeseed meal supplies to the feed sector.

The changing pattern of foreign trade in protein crops could be a sign of a positive structural change in the sector, though it was not related to the 2003 measures. Field bean exports have increased since the reform; for field peas, though exports have declined, they have declined much less sharply than output. In both cases there are export markets, in South Asia for field peas and in North Africa for field beans, which pay premium prices for food grade products.

Minimal import tariffs mean prices in the sector have not been affected by the 2003 reform.

Deadweight. There is no deadweight in the application of the measures, when the effect of the current measures is compared with those applied until 2003. However, the current measures are compared with simulations of full decoupling, producer questionnaires and econometric analyses of protein crop area changes imply that the reduction in 2008/09 areas if no coupled aids were paid would be between 2.9% and 8.6%. Comparing budgetary costs of coupled payments with the area maintained in protein crops by the measures, and applying the results from the three alternative approaches, we estimated that a budgetary outlay of €650 to €1,950 is needed to keep one marginal hectare in protein crop production.

Unintended side effects. An unintended consequence of the measures was to provide weak encouragement to expand protein crop areas in regions with low reference yields, while weakly discouraging plantings in regions with higher than average reference yields. The net effect of this geographical redistribution of coupled payments appears to be very minor.

Simplification of the administrative measures. There is no evidence that the changes brought about by the 2003 reform have caused an extra administrative burden for producers. Similarly, in terms of the administrative burden for government agencies, the general consensus was that the administrative workload associated with protein crop measures was a very small element of the overall administration required by the CAP and the CAP payments to farmers. No changes were detected in this administrative workload following the 2003 reform.

Evaluation Question 6: Coherence of the CAP measures

To what extent are the CAP measures applicable to the protein crop sector after the 2003 changes coherent with the overall concept and principles of the 2003 reform of the CAP?

Coherence of the CAP measures with the overall concepts and principles of the CAP is assessed in relation to three main objectives: a) economic sustainability of agriculture, b) social sustainability of agriculture, and c) environmental sustainability of agriculture.

The answer to this question is based mainly upon answers to previous Evaluation Questions. These are supplemented by data collected during preparation of the case study monographs.

1. Indicators and evaluation tools:

The judgement criteria, indicators and data sources relevant to this question are summarised in the following table.

Table EQ6.1: Judgement criteria, indicators and data sources regarding coherence

Judgement Criteria	Indicators	Data Sources
The extent to which the effects of the CAP measures applied in the protein crop sector are coherent with the objective of economic sustainability of agriculture	Levels of import tariffs	TARIC
	Foreign trade as a % of demand	COMEXT
	Comparison of internal market prices with international prices	FAO UNIP
	Comparison of income (excluding decoupled payments) including rotation benefits, before and from 2004	FADN Producer interviews Producer questionnaires
	Proportion of coupled payments in producer incomes, for protein crops and alternative COP crops	National and regional sources Producer interviews
	The competitiveness of local protein crop output vs. foreign production and vs. alternative sources of protein feed	Processor interviews Research institutions in Canada and Australia US Department of Agriculture
The extent to which the effects of the CAP measures in the protein crop sector are coherent with the objective of the social sustainability of agriculture	The generation of employment in protein crop production	National and regional sources Producer interviews
	The maintenance of employment in local feed compounding	Processor interviews FEFAC
The extent to which the effects of the CAP measures in the protein crop sector are coherent with the objective of the environmental sustainability of agriculture	Environmental impact of protein crop production, including the significance of the organic sector of the market	Case study interviews *La filière protéagineuse, quels defis?* Edited by Guéguen & Duc, 2008 Grain legumes and the environment: AEP, 2004
Unintended impact of other CAP measures on the protein crop sector	Changes in the profitability of field peas vs. wheat between 1993 and 2006	DG Agri National and regional sources

2. Coherence of the 2003 CAP measures with the objective of economic sustainability of agriculture

Economic sustainability of protein crop output is intrepreted as having three main aspects:

- Competitiveness with production outside the EU, revealed by barriers to foreign trade in protein crops, the share of foreign trade in domestic demand and in outlets for local production and the level of internal protein crop prices vs. international prices;
- Competitiveness with other COP crops in full incomes/hectare, dependence upon coupled payments, productivity in the field, and risks in production;
- Competitiveness in end-use markets, both as a protein feed ingredient and as a food.

2.1. Competitiveness with production outside the Community

In terms of trade barriers, the EU market for protein crops is very open to foreign sources of supply. MFN import tariffs on field peas are 0%, on sweet lupins 2.5% and on field beans 3.2%.

Foreign trade, both inwards and outwards, is an important feature of the domestic market. Net imports of field peas were over 15% of local demand in 2006-2007, up from 5% in 2000-2003, but exports in 2006-2007 were over half the import volume, as EU producers took advantage of premium prices paid for food grade field peas in South Asian markets.

Exports of field beans have increased since 2003; by 2006-2007, net exports totalled 49% of domestic demand. Again, EU exports were mainly of premium priced food grade products.

The EU is a very small sweet lupin exporter, but net imports met 26% of demand in 2006-2007.

The openness of the market is demonstrated by the close link between field prices in Canada (the leading exporter) and the EU, once freight costs from Canada are included.

Table EQ6.2 demonstrates the ability of EU exports of field peas and field beans to compete successfully in higher value food markets. From 2003 to 2007, average export prices were over 20% higher than import prices (the identical values for average field pea and bean unit import values over the five years are purely coincidental, since yearly unit values differ).

Table EQ6.2: Average EU-27 field pea and field bean import prices, 2003-2007 (€/tonne)

	Imports	Exports
Field pea	167	204
Field beans	167	210

Source: COMEXT
Note: The field pea prices refer to extra-EU trade; the same is true of field bean exports. Field bean import prices are for intra-EU trade, since the extra-EU unit prices are very high in some years, since volumes are often very low.

2.2. Competitiveness with alternative COP crops

The cost and income estimates derived in Chapter 6 are summarised in Table EQ6.3, in which the values are simple arithmetic means of the relevant items for all five case study regions. The terminology introduced earlier in this report is as follows: the gross margin at market prices is the gap between sales revenues and direct costs. The rotation benefits are the value of the higher common wheat yield and nitrogen savings in the following crop. Income is the sum of all the elements listed in the table. Decoupled payments have not been included in this analysis, since they are paid equally on protein crops and other COP crops, and thus do not affect the relative advantage of one crop over another in their incomes per hectare.

Table EQ6.3: Comparisons of the arithmetic means of incomes (excluding decoupled payments), in 2001-2003 and 2006-2007, for the five case study regions for field peas, field beans and other COP crops (€ per hectare)

	Gross margin (GM) at market prices	Rotation benefits	GM + Rotation benefits	Coupled aids	Income
2001-2003					
Field peas	206	100	306	379	685
Other COP crops	404	8	413	327	740
2006-2007					
Field peas	241	128	369	99	468
Other COP crops	519	12	531	44	576
2001-2003					
Field beans	270	102	372	403	775
Other COP crops	501	8	508	356	864
2006-2007					
Field beans	230	138	369	53	421
Other COP crops	709	13	722	0	722

Source: Derived from analysis in EQ4 of the data from case studies and FADN.
Note: The comparison for field peas and other COP crops in the top half of the table is the simple arithmetic mean of the data for all five regions for which field pea gross margins data were available. The comparison for field beans is undertaken only for the two regions (Niedersachsen and East Anglia) with gross margin data.

We observe that average gross margins at market prices for all case study regions are much lower for protein crops than for other COP crops, and the difference between them widened after the 2003 CAP measures. Once rotation benefits are included, the advantage for other COP crops over the protein crops is smaller, but it is still evident, and widens after the reform.

Coupled aids are bigger for protein crops than other COP crops. For both classes of crops, the value of coupled aids declined after the reform, due to the shift towards decoupled payments.

The gap between incomes per hectare for field peas and other COP crops widened from €55 in 2001-2003 to €108 in 2006-2007. For field beans, the income disadvantage against other COP crops widened from €89 to €301 per hectare in the same periods.

This implies that the economic competitiveness of protein crops deteriorated after the 2003 reform, even though the value of externalities, via the rotational benefits, increased.

At the same time, protein crops are perceived as having a poor trend in yields. Average yields on protein crops have performed worse than those for other COP crops since 2000. In the discussion of yields in Chapter 3, it was concluded that protein crops as a group, and field peas in particular, experienced a particularly poor yield performance from 2000 to 2007. One explanation for this decline is adverse weather conditions at a critical time in recent years[58].

A further important element in producers' crop choice is an assessment of the riskiness of protein crop farming vs. alternative crops. In EQ1 and EQ3, coefficients of variation were estimated for the gross margins and yields of protein crops and other major COP crops. The conclusion from that analysis was that protein crops, durum wheat and rapeseed are typically the riskiest in terms of yields and gross margins. However, a relevant factor for rapeseed is that a sizeable proportion was grown on set-aside land, where the main alternative was often simply to leave the land fallow.

This reinforces the conclusion that there is no evidence that the CAP measures applied to the protein crop sector affected the overall economic competitiveness of protein crops.

[58] *The dynamics controlling the grain legume sector*, Anne Schneider, COPA-COGECA debate on grain legumes, March 2008.

In theory, the 2003 protein crop measures should not have harmed the economic competitiveness of these products. The measures did not put protein crops at a disadvantage against other COP crops; indeed, for the average protein crop producer, they maintained the advantage that protein crops enjoyed over other COP crops in coupled aids prior to 2004.

The reality showed that the sector declined due to factors exogenous to the 2003 reform. They appear to lie in structural problems that include sharp declines in feed demand for protein crops and the perceived loss of critical mass along the supply chain. Yet, interviews revealed a few segments in which, even if positive output growth was not evident, at least the rates of decline were slower than those in the sector as a whole. These were:

- Production of higher quality products for food use, primarily for export. The Appendix containing a case study of Canada reveals the importance of these premium markets in underpinning the expansion of Canadian field pea output, while EU supplies declined.
- On-farm feed use, which is reflected, for example, in the performance of Poland, where the area under protein crops has expanded in relation to the level before accession. This area includes a sizeable proportion planted to mixed cereal-protein crops.
- Organic production, although this appears to be significant only in Germany, and even there the area has fallen. Organic production is attractive to mixed crop-livestock producers who are concerned about the traceability of their protein feeds.

2.3. Competitiveness in feed and food end-uses

Interviews with feed companies revealed that protein crops are no longer viewed as a vital ingredient in their formulations. In 2006-2007 they represented 2.6% of EU-27 feed ingredient use in protein content (down from 4.2% in 2000-2003). This decline is revealed by Table EQ6.4.

We noted earlier in this study that the loss of competitiveness as a feed ingredient was linked to the ban on the use of meat and bone meal in most animal feeds from 2001. This removed a valuable high protein feed that complemented the comparatively low protein content of field peas and beans. Another important factor that reduced demand for protein crops in feed was the greater supply of rapeseed meal as a consequence of CAP energy crop measures.

The ready availability of soybean meal, with over twice the protein content of field peas, was attractive to compounders, especially those in portside locations, which was where a growing proportion of feed plants were located over the past decade. Also, CAP reforms outside the protein crop sector had made cereals a more competitive feed ingredient since the 1990s.

Regression analysis of field pea prices revealed that the popular statement by many farmers, that a 2:1 feed wheat-soybean meal mixture provides an ideal replacement for field peas, yielded a very close approximation to actual wholesale field pea prices in Brittany, a major French feed compounding centre. With both feed wheat and soybean meal available all year round on a large scale, processors found such mixtures attractive alternatives to protein crops.

Table EQ6.4: Composition of protein feed ingredients ('000 tonnes, protein content)

	Oilseed Meal	Field Peas	Field Beans	Sweet Lupins	Dry Fodder	Meat and Bone Meal	Other Inputs	Total
2000-2003	18,695	635	200	103	862	476	1,608	22,580
2004-2005	19,310	754	243	100	871	309	1,361	22,947
2006-2007	20,305	389	140	75	794	288	1,075	23,066

Sources: Analysis in EQ3, derived from data from COMEXT, DG Agri., FEFAC, AC Toepfer, USDA.
Note: This covers all the main protein feed ingredients apart from fish meal and synthetic amino-acids.

The premium priced market for protein crops in human and pet food end-uses has become comparatively more important as an outlet for protein crops as the sector has contracted. This is revealed in two respects: the first, mentioned above, is the increased importance of exports (primarily of these higher value products) in recent years; the second is the greater reliance upon non-feed outlets in the domestic market.

The discussion in Chapter 3 revealed that the proportion of local demand for protein crops destined for direct food uses and processing (for food ingredients) rose from 12.0% in 1993-1999 to 16.6% in 2000-2003 to 18.9% in 2004-2008.

3. Coherence of the 2003 CAP measures with the objective of social sustainability

In this section, we consider the impact of the CAP measures in the protein crop sector on employment, both in agriculture and in feed compounding.

3.1. Agricultural employment

The producers' questionnaires asked informants about their overall employment on-farm and the proportion of the workers' time that was devoted to the production of protein crops. Their responses demonstrated that protein crops are typically a very minor part of the farm workload. Aggregating returns across all MS, one finds that fewer than 5% of paid employees spent more than 20% of their time on operations linked to protein crop production.

In all, employment generated by protein crops is a minor aspect of farm operations. Farmers appear glad to absorb any labour released from protein crops in their other COP crops, which is in line with the broad trend towards simplified farming systems noted in several interviews.

Protein crops were sometimes viewed as a welcome means of using otherwise under-employed labour if plantings occurred in springtime. However, at harvest time, demand for labour and machinery often clashed with that for cereals, particularly for field peas, for which the window of opportunity before pods burst and/or the crop became lodged, was short.

3.2. Employment in feed compounding

Processors emphasised, during interviews, the minor role now played by protein crops in their feed compounding. As protein crop availability declined, the use of these ingredients became increasingly irksome, since separate bins had to be maintained for their use, and these were increasingly hard to fill for year-round use. However, the labour time specifically associated with protein crop use is so minor that it is not tabulated separately, especially since most tasks associated with storage, mixing and distribution are highly automated.

FEFAC, the European association representing the feed compounding industry, estimates[59] that its sector employs 110,000 workers on 4,500 sites in the whole of Europe (including some non-EU countries), i.e., fewer than 24 workers per site. Since protein crops represented a mere 1.3% by weight of total EU compound feed tonnages in 2007, the employment that is linked specifically to protein crop use is not significant in the overall picture.

We conclude, therefore, that the 2003 measures in the protein crop sector had no impact on employment within the feed compounding industry.

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[59] FEFAC, *Feed and Food Statistical Yearbook, 2007*, Brussels.

4. Coherence of the 2003 CAP measures with environmental sustainability

In this section, we examine the extent to which the CAP measures have been coherent with the objective of the environmental sustainability in protein crop production.

4.1. Reductions in input use

Protein crop production was widely acknowledged by producers in questionnaires and in interviews to have significant benefits in terms of nitrogen-fixation and other forms of savings in input use in following crops, as well as higher yields in the subsequent crop.

One method of gauging the reduction in input use is to analyse the data on direct costs per hectare of alternative crops, presented in the discussion of EQ1. Direct costs are principally inputs such as fuel, fertiliser and chemicals, which have an environmental impact.

Table EQ6.5 compares simple arithmetic means of the direct costs per hectare for the number of case study regions for which data are available on the crops listed in the comparison. For example, only two regions provided data on field bean costs, and their direct costs for common wheat and rapeseed are listed in the table alongside the field bean costs.

We observe that, in every case, the protein crop has lower direct costs, confirming that they are less intensive in input use than other COP crops.

Table EQ6.5: Comparisons of arithmetic means of the direct costs for alternative crops 2001-2003 and 2004-2006 in case study regions (€ per hectare)

Regions covered		2001-2003	2004-2006
Seine Maritime, Eure et Loir,	Field peas	310	318
Niedersachsen, East Anglia,	Common wheat	380	397
Castilla-La Mancha			
Seine Maritime, Eure et Loir,	Field peas	326	326
Niedersachsen, East Anglia,	Rapeseed	393	431
Niedersachsen, East Anglia,	Field beans	243	256
	Common wheat	310	306
	Rapeseed	451	486

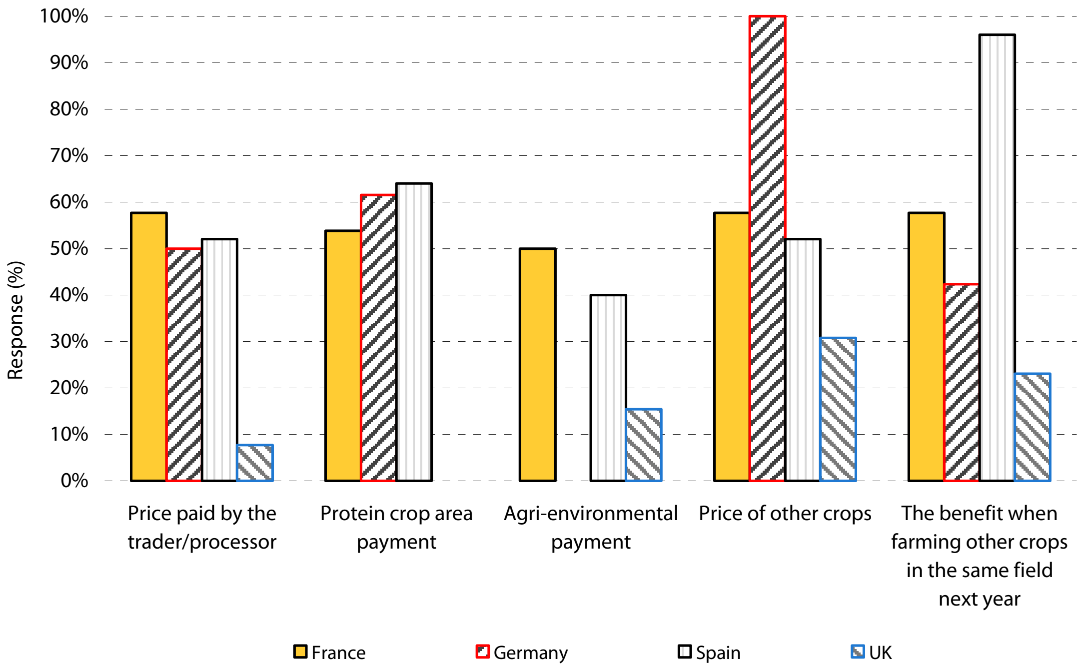
Source; Case study monographs and the analysis in EQ5.
Note: These figures are simple arithmetic means of the data for the regions in the analysis.

5. Evidence from case studies

Producer questionnaires posed several questions about the environmental and economic benefits of protein crop farming. The samples are small and cannot be taken to be representative of the sector as a whole, but they provide indications of farmers' views. The key results regarding the major influences upon decisions to plant protein crops are illustrated for the selected EU-15 and the EU-12 MS in Diagrams EQ6.1 and EQ6.2, respectively.

We observe that rotational benefits for following crops were among the most important influences in the EU-15 MS, and that agri-environmental payments were mentioned by close to half the French and Spanish respondents as a positive influence on protein crop farming. For the two EU-12 MS, the rotational benefits were a major consideration for 70% of the respondents, but 60% also cited agri-environmental payments as an important factor.

Diagram EQ6.1: The main influences in EU-15 producers' decision to grow protein crops



Source: Producer questionnaires for case studies. The total number of completed responses was 82 in these MS.

Diagram EQ6.2: The main influences in EU-12 producers' decision to grow protein crops

Source: Producer questionnaires for case studies. The total number of completed responses was 37 in these MS.

Organic protein crop production is judged to be more sustainable than conventional farming systems from an environmental perspective. In the research for each case study monograph, questions were posed about the importance of the organic sector in the protein crop sector.

The experience differs widely across MS, though information was more readily available from producers than from government agencies, which often do not keep separate data on protein crop areas within their overall organic area statistics. A particular point mentioned by these agencies was that organic on-farm feed use of protein crops was frequently grown in mixtures with cereal crops, and data for this category were often not collected separately.

In France, the organic segment in 2006 was stated by UNIP, the inter-professional association for the protein crop sector, to represent slightly over 2% of total output, but UNIP's data revealed that this share had been declining in importance. In Hungary, Poland and the UK, the market share was reported in interviews to be of the order of 1%, but to be growing. 10% of the respondents to the Spanish questionnaires indicated that they had organic production, but interviews with the feed sector suggested that the overall market share was close to 1%.

Germany presented a completely different picture. Data from the Land government in the case study region, Niedersachsen, revealed that the output of organic protein crops has fallen since 2005, but not as fast as the sector as a whole. In that region, the organic segment accounted for roughly 60% of the planted area. National producers' organisations estimated that maybe 40% of national output was organic, held back in part by lower yields.

A major reason for this interest in organic production in Germany was that it was closely tied to organic meat production, much of it on the same holdings. Integrated organic protein crop farming ensured that the feed was traceable if queries arose, and that it was also non-GMO.

6. Conclusions

The questions posed at the start of this discussion are repeated below:

To what extent are the CAP measures applicable to the protein crop sector after the 2003 changes coherent with the overall concept and principles of the 2003 reform of the CAP?

The picture that emerges from this discussion of the coherence of the CAP measures with the overall concept and principles of the 2003 reform is a mixed one.

Regarding the economic sustainability of the sector, when this is judged by competitiveness with non-EU supplies, the conclusion from our analysis is positive. Import tariffs are very small or zero, ensuring that foreign trade, both inwards and outwards, is an important feature of the EU supply and demand balance for these crops. This outcome, however, is the result of measures pre-dating the 2003 reform; as such, it is not directly attributable to 2003 measures.

When competitiveness is measured in relation to profitability per hectare vs. alternative crops, the sector, on average, lost ground in 2006-2007 vs. 2001-2003. In this respect, we conclude that the 2003 measures have failed in the objective of supporting the competitiveness of protein crops vis-à-vis other COP crops. However, the reasons cannot be attributed to the specific protein crop measures, which were, on average, neutral in their impact upon the relative profitability of protein crops vs. other COP crops; changes in market prices were a much more important factor.

From the perspective of feed demand, too, the sector's economic competitiveness has weakened. Feed compounders have turned away from the use of protein crops, partly because bans on the use of meat and bone meal in most feed uses in 2001 removed from the feed sector a high protein ingredient that complemented the low protein content of field peas and field beans. Major feed companies also reduced protein crop use because rapeseed meal availability rose as a result of CAP energy crop measures, and rapeseed meal has the added attraction that its protein content (38%) is higher than that of field peas (21%), field beans (26%) and sweet lupins (34%).

There is no evidence, however, to conclude that the reduced use of protein crops by the feed compounding industry is a consequence of 2003 CAP measures in the protein crop sector.

There are three respects in which the economic competitiveness of protein crop production in specific outlet has been better maintained than the sector as a whole. These are in the development of organic production; in the use of protein crops for on-farm feed (with associated environmental benefits from reduced “feed-miles” in the supply of inputs); and in the production of high quality, premium-priced protein crops, for third country export markets for food, and also for pet food. Yet, none of these is a result of the measures introduced to the protein crop sector from 2004.

The social sustainability of the sector, judged in terms of employment generation, has not been affected by the reform. Protein crops represent a small part of the use of labour on those farms producing the crop, and declining protein crop output was not reported to have caused any change in employment. Instead, workers were switched to work on other major COP crops, a trend in line with the adoption of simplified farming systems.

In feed compounding, protein crops now represent only a small share of all inputs (1.3% in 2007). Indivisibilities in storage are leading compounders, whose plant scale is rising over time, to reduce their use of protein crops and thus use their capacities more intensively and at lower unit cost. This response is, however, not a result of the 2003 measures.

We conclude that the 2003 reform did not induce any direct changes in the social sustainability of the protein crop sector.

In terms of environmental sustainability, protein crops represent an improvement over most other COP crops, by virtue of their low input use and rotational benefits. The 2003 reform measures in the sector did nothing specific to promote, or discourage, protein crop farming. More general CAP measures, such as the encouragement of organic farming, have had a beneficial effect in the protein crop sector in one MS, Germany. In addition, a significant minority of producers in their questionnaires identified agri-environmental payments as an important factor in their decision to cultivate protein crops.

Evaluation Question 7: CAP objectives and producer and user needs

How far do the objectives of the CAP reform correspond to the needs of producers and those of the compound feed industry and livestock farmers?

The answer to this question draws upon answers to previous Evaluation Questions.

1. Indicators and evaluation tools:

The judgement criteria, indicators and data sources relevant to this question are summarised in the following table.

Table EQ7.1: Judgement criteria, indicators and data sources regarding cap objectives and producer and user needs

Judgement Criteria	Indicators	Data Sources
Fair living standard for agricultural producers	Time series of income, including decoupled payments, from MS selected for case studies, including an allowance for rotational benefits	National and regional government agencies and academic institutions Case study interviews Producer questionnaires FADN
Stability of producer incomes	Coefficient of variation of income (including decoupled payments) on rotations including protein crops before and after 2004	National and regional sources Producer interviews FADN
Availability of protein feeds for the compound feed and livestock sectors	The share of imports in protein crop supplies	COMEXT
	The share of domestic protein crops in the overall supply of protein feed for the internal market	FAO, DG Agri US Department of Agriculture AC Toepfer
	Ease of substitution of alternative protein feeds, including biofuel by-products, for protein crops in feed formulations	Processor interviews Econometric analysis of relative protein feed prices as a function of relative supplies of such feeds
Reasonable prices for consumers	Comparison of internal market prices with international prices	National and regional sources Processor interviews

2. Effects of the 2003 measures on fair living standard for producers

Fairness in living standards of protein crop growers is judged in three ways:

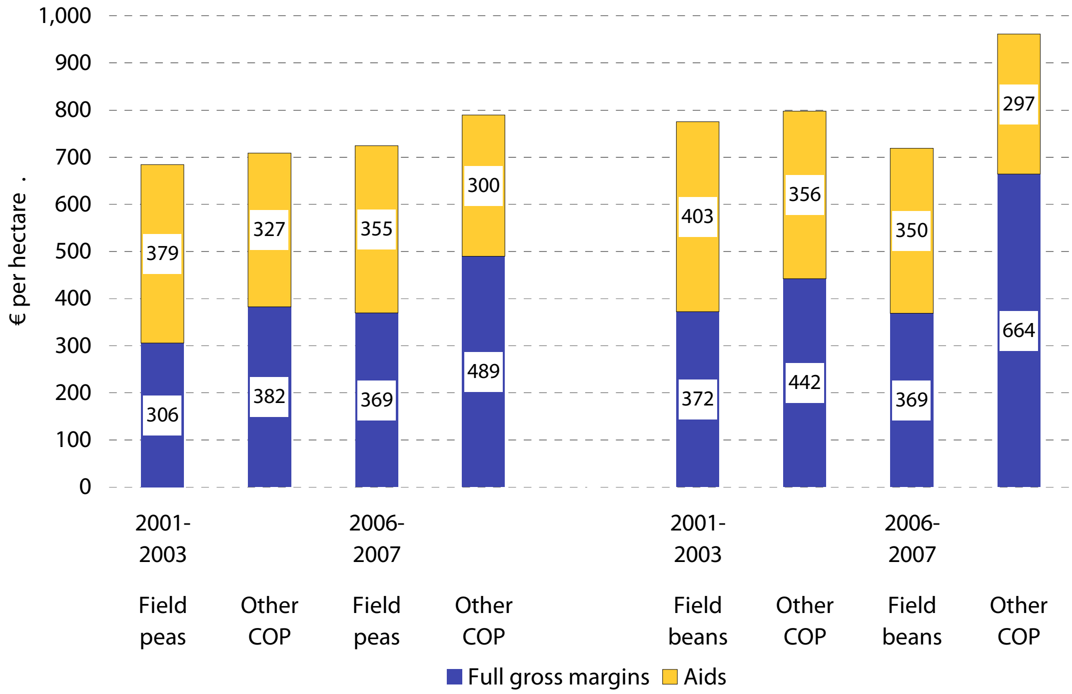
- Inter-temporally, comparing incomes per hectare of protein crops before and after the 2003 reform measures were implemented;
- Cross-sectionally, comparing incomes from protein crops in the same periods of time with those earned from the production of other COP crops; and,
- Since protein crops are typically only a small part of a farm's operations, comparing incomes across holdings with a different degree of dependence upon protein crops.

2.1. Inter-temporal comparison

In this section, we compare full incomes per hectare of field peas, field beans and other COP crops as arithmetic means of the data collected from the four EU-15 case study MS. The total income is divided between full gross margins (gross margins at market prices plus the rotational benefits for the following crop), and aids, both coupled and decoupled.

For field peas, the sample in Diagram EQ7.1 covers all five case study regions, and the "Other COP" crop figure is the average of other COP crops in the same five regions. For field beans, the sample covers only two regions (Niedersachsen and East Anglia), and the other COP figures relate to the same two regions.

Diagram EQ7.1: Composition of full incomes from protein and other COP crops (€ per ha.)



Source: Analysis of gross margins from case studies. Details are provided in EQ6.

We observe that, comparing 2000-2003 with 2006-2007 (after SPS had been implemented in full in every EU-15 MS), the measures reduced overall coupled and decoupled aids per hectare by 6% for field peas and by 13% for field beans.

Full gross margins rose by 21% per hectare for field peas, while they fell 1% for field beans.

Full incomes per hectare increased by 6% for field peas, but it fell by 7% for field beans.

2.2. Cross-sectional comparison

Diagram EQ7.1 permits a direct comparison to be made of the trends in full incomes across crops. When the full income earned per hectare of other COP crops is compared with the average full income on protein crops in the same regions, we find that average incomes per hectare were higher in the production of other COP crops than they were on field peas and beans, both before and after the reform. The income advantage offered by other COP crops vis-à-vis both protein crops widened after the reform.

2.3. Comparisons by degree of dependence on protein crops

The sole source of data on incomes on similar holdings with different degrees of dependence upon protein crop production is the FADN database. This information only covers the period until 2006 and is only available for EU-15 MS prior to the reform. Many comparisons of incomes were prepared on several different bases (per hectare, per family work unit, per annual work unit) for COP specialists and mixed crop-livestock producers and for differing proportions of protein crops in the overall utilisable agricultural area (UAA) on holdings. The analysis, which contrasted the mean incomes and the dispersion of incomes from 2000 to 2006 for holdings with different degrees of dependence on protein crops, did not yield any statistically significant results. The variability in the outcomes and the small sizes of the samples available from the FADN database make it impossible to draw any clear-cut conclusions regarding any differences in the impact of the reform between farms with a comparatively large, medium or small proportion of their holdings planted to protein crops.

3. Effects of the 2003 measures on the stability of producers' incomes

The discussion of EQ3 included a consideration of the impact of the CAP measures on producers' incomes. The analysis led us to conclude that the introduction of special aids in the 2003 reforms had a negligible impact upon protein crop producers' incomes when the situation in 2006-2007 (after full implementation of the SPS in all EU-15 MS) is compared with that in 2001-2003. In this section, we will focus upon their impact of the 2003 measures on the stability of incomes. The time span of the relevant data series is limited by the end-date of 2006 for the FADN database, which is used as the basis for information on coupled and decoupled aids, and by the detailed empirical agronomic data regarding the rotational benefits from protein crops, which only begin in 2001. Therefore, we do not attempt to distinguish between the years before the implementation of the 2003 reform and those after the implementation in order to have a reasonable number of data points, but we review the impact of the measures as a whole on income stability over the six years from 2001 to 2006

The indicator used to assess income stability is the coefficient of variation of full incomes and the coefficient of variation of full incomes without the contribution of coupled and decoupled aids (i.e., the sum of gross margins at market prices and rotational benefits). We compare the volatility of incomes in these two alternative measures of income per hectare in Table EQ7.2. We see that, in six of the seven cases, CAP measures, by providing a stable element of incomes to protein crop farmers, increased income stability over time[60] in the regions surveyed.

Table EQ7.2: Coefficients of variation of protein crop incomes, with and without aids, 2001-2006

		Full income	Gross margins at market prices plus rotation benefits
Field peas	Seine Maritime	18%	37%
	Eure et Loir	7%	14%
	Castilla-La Mancha	52%	-250%
	Niedersachsen	9%	17%
	East Anglia	22%	23%
Field beans	Niedersachsen	10%	17%
	East Anglia	22%	19%

Source: Derived from analysis of case srtudy data and FADN database.
Note: Full income is the sum of the gross margin, coupled and decoupled aids and the benefits from rotation

[60] The coefficient of variation of field peas in Castilla-La Mancha is negative because the mean is negative.

4. The effects of the 2003 measures on protein feed availability to end-users

In this section, the availability of protein feeds for the compound feed and livestock sectors will be assessed in three ways: the importance of imports in meeting the domestic demand for protein crops; the importance of protein crops in meeting protein feed demand in the EU market; and the ease with which alternative sources of protein feed may be substituted for protein crops in feed formulations. These are all respects in which it is the broader measures in the CAP, rather than the protein crop reform itself, that affected the behaviour of protein crop demand. This is because the measures in the protein crop sector were neutral in their impact upon the average protein crop producer, and thus, by themselves, should have had a minimal effect upon supplies to end-users.

4.1. The share of imports in the domestic market for protein crops

Information about the share of imports of protein feed in the domestic market was discussed at length in EQ5. The main conclusions drawn from that discussion were:

- Import tariff barriers are minimal (from 0% on field peas to 3.2% on field beans). Thus, the local market is very open to imports, as may be seen from analysis of trade flows.
- Between 2000-2003 and 2006-2007, net imports of field peas rose from 5.0% to 15.5% of domestic demand, demonstrating good access to foreign supplies. There continues to be a large volume of field pea exports for premium uses, in human and pet food. Hence, the EU reliance on imports for feed is much higher than net import shares might suggest. If all EU exports were for food use and all imports were destined for feed uses, imports supplied nearly one third of feed uses of field peas in 2006-2007.
- The EU has raised its field bean exports, transforming the EU balance from one of modest net imports to one of significant net exports (as with field peas, these exports are mainly destined for food uses in third country markets). The EU is a net importer of sweet lupins, but the volumes are now modest in relation to past volumes, and in relation to field pea and bean imports.

4.2. The importance of protein crops in meeting EU protein feed demand

The share of protein crops in protein feed use has fallen from 3.4% in 2003 to 1.5% in 2007, and it is estimated to have fallen further in 2008. The decline was due to several factors such as the availability of other feed ingredients in the EU market and external shocks, notably BSE.

Specific causes of the lower importance of protein crops identified earlier in this report are:

- The banning of meat and bone meal from most animal feed applications from 2001.
- Much larger supplies of rapeseed meal, as a by-product of biodiesel output.
- The ready availability of soybean meal, imported free of tariffs, or from local processors.
- CAP reforms, by lowering intervention prices for cereals since 1993, made them more competitive in feed uses. When combined with soybean meal, feed wheat offers users an amino-acid profile that is similar to that offered by protein crops.
- Unlike protein crops, whose supplies are very seasonal, obliging compounders to buy their annual needs in a short period, feed cereals and soybean meal are readily available year-round in large quantities, which appeals to processors as it minimises their need to hold large stocks for lengthy periods.

None of these factors can be linked directly to 2003 protein crop measures.

4.3. The ease of substitution of protein crops in feed formulations

Evidence of the ease of substitution of alternative protein ingredients is provided by the lack of concern shown by feed compounders in the face of the falls in local protein crop output. Processor interviews and questionnaires gave insights into their alternative ingredient choices.

Most of those who responded stated that soybean meal was the preferred substitute for all three protein crops; rapeseed meal was second, followed by sunflower meal.

Table EQ7.3 summarises the responses to questions about processors' reactions to a further loss of protein crop supplies and their reactions to the availability of by-products of biofuel production and crushing of local oilseeds (thus excluding soybean meal) as alternative feeds.

The table reveals that most compounders were unconcerned about the possible loss of protein crop supplies. The loss of sweet lupins worried none of the respondents. For field peas and beans, 45% and 38%, respectively, of respondents expressed some concern; of these, a majority expressed moderate or major concern. When asked for specific reasons for this concern, livestock producers' worries about GMO inputs were most commonly mentioned.

The greater availability of rapeseed meals was seen as an important factor in reducing demand for protein crops. 40% said that its enhanced supplies had a major impact (of more than 25%) on protein crop demand, and 30% said that its impact was moderate (10-25%). Sunflower meal had a more modest impact on protein crop demand, but it was considered to have had a major or moderate impact by 47% of those who responded. DDG, a by-product of ethanol dry milling, had a major or moderate impact for 38% of the respondents.

Table EQ7.3: Impact of loss of protein crop supplies on feed compounders and the main beneficiaries from reductions in protein crop supplies (% of those who responded)

Concern about loss of supplies of protein crops				
	Nil	Small	Moderate	Major
Field peas	55%	20%	5%	20%
Field beans	62%	5%	19%	14%
Sweet lupins	100%	0%	0%	0%
Impact of biofuel and oilseed by-products on protein crop demand				
	Nil	Small	Moderate	Major
Rapeseed meal	25%	5%	30%	40%
Sunflower meal	33%	20%	27%	20%
Distillers' dried grains	50%	13%	25%	13%

Source: Analysis of the 28 processor questionnaires, which provided responses to this particular question.

On-farm feed use of protein crops is reported to have been more resilient than demand by feed compounders, partly because this end-use is more difficult to replace than others, since producers would have to purchase their protein feed requirements.

In Poland, there has been an increase since the period immediately before its accession in the area under protein crops, including mixtures with cereals. This was driven primarily by on-farm feed use.

In the producer questionnaires, just under 40% of all respondents stated that they used protein crops for on-farm feed. Not all of these used all their production on their own farms. Approximately one quarter said that they used it entirely in their own feeding operations in 2008, an increase from 20% in 2003. however, the modal group in the respondents in both 2003 and 2008 were those who used under 20% of their output for on-farm feed.

5. Effects of the 2003 measures on reasonable prices for consumers

The openness of the EU market to imports of protein crops has been reflected in local prices, which, for these crops in feed uses, are close to world market prices. The evidence presented in EQ6 revealed that differentials between protein crop prices by geographical location closely reflect world market prices and transport costs.

This openness to imports is a consequence of long-standing measures that pre-date the 2003 reform; but the situation did not change after the reform. Accordingly, we conclude that the reform maintained reasonable prices for consumers.

6. Conclusions

The questions posed at the start of EQ7 are repeated below:

How far do the objectives of the CAP reform correspond to the needs of producers and those of the compound feed industry and livestock farmers?

With regard to the effects of the 2003 reform on fair living standards our assessment reveals that, when 2000-2003 is compared with the years after full implementation of the measures (2006-2007), there was a mixed outcome, Full income per hectare rose 6%, including rotational benefits, for field pea producers, but declined by 7% for field bean producers. No comparable data are available for sweet lupins. Ideally, full income would be expressed per holding, but data are not available about changes in the size of protein crop holdings.

In the same years, average full incomes earned on other COP crops were consistently higher than those on the two protein crops, and the divergence widened after 2003. This suggests that, if fairness is judged in terms of the maintenance of incomes per hectare over time and in relation to alternative opportunities in COP crop production, the outcome may not have represented full fairness in living standards for protein crop producers.

This result was not caused by the 2003 measures in the protein crop sector, which should have had a broadly neutral effect upon protein crop producers' incomes. Instead, it was the result of outside influences.

The stability of producers' incomes is enhanced by the CAP measures. Together, the systems of coupled and decoupled payments reduced income instability (measured by the coefficient of variation) substantially vis-à-vis the volatility of gross margins at market prices.

Where the needs of protein crop producers are interpreted in terms of the maintenance of full income per hectare, the experience since 2003 may be seen to have been mixed. As noted above, field pea producers in the study regions recorded a minor improvement, while field bean producers experienced a minor deterioration in their full incomes per hectare.

If their needs are interpreted, instead, in terms of the competitiveness of protein crop production vs. other COP crops, the experience since 2003 has been unfavourable.

In none of these respects were the 2003 protein crop measures the cause of the changes. External factors, most notably the changes in world market prices, were the main causes.

In one major respect, we conclude that the 2003 measures have met an important need of producers; this was in providing stability in their full incomes

Regarding the effects of the 2003 measures on meeting the needs of users, the supply of protein crops is no longer of much concern to most feed compounders. Better availability of protein ingredients as a by-product of biofuel output, ready soybean meal supplies, and bans on meat and bone meal use in many feeds have induced compounders to replace protein crops in their formulations.

The impact of these external developments on the supply of feed inputs to compounders means that no direct causal link can be established between the 2003 measures and the decline in protein crop supply to feed compounders. Despite this decline in overall feed demand for protein crops, a few specialised markets continue to favour protein crops; these include the non-GMO and organic segments, on-farm feed demand, and premium priced human and pet food uses.

The most important need of users, including livestock producers as purchasers of mixed feeds, is almost certainly the freedom of access to feed ingredients at world market prices, so as not to imperil the international competitiveness of the EU feed and livestock sectors. In this respect, the 2003 measures in the protein crop sector continued to meet the needs of users.

With regard to the effects of the 2003 measures on the reasonableness of prices for consumers, the openness of the EU market for protein crops to imports and limited tariff barriers have kept internal market prices closely in line with those in the international market, and ensured that prices for these products are reasonable.

This was the situation before the 2003 measures and was not altered by that reform, leading us to conclude that the 2003 reform maintained reasonable prices for consumers.

In summary, the 2003 protein crop measures were relevant to producers in two main respects, helping to maintain producer incomes after the reform, and continuing to provide stability to producer incomes.

For users, the reform made no changes from the previous measures. After 2003, domestic prices remained closely linked to world market prices.

Chapter 8: Conclusions and Recommendations

1. Conclusions

1.1 EQ1: Impact of the 2003 measures on protein crop production

EQ1 To what extent have the CAP measures applicable to the protein crop sector affected the output of protein crops, with regard to the choice of crop, area; yield; prices paid to producers; geographical distribution? To what extent has the special aid for protein crops been an incentive to increase the production of these crops? (Special attention will be paid to impacts linked to crop rotation.)

1.1.1. Effects of the 2003 reform on the area planted to protein crops

The EU-27 protein crop sector contracted following the 2003 reform. Reviewing the trends in area of individual protein crops, however, their fortunes have been quite different. The area under field peas, which is the protein crop with the largest area in the EU 27, was 24% lower in 2004-2008 than it had been in 2000-2003. In contrast, the field bean area rose 8% and the sweet lupin area rose 18% over the same period. A comparison of the coefficients of variation of yields reveals that field beans and sweet lupins had less yield risk than field peas in the period 2000-2007, which would increase their attraction to risk-averse producers.

When one considers the nature of the 2003 protein crop measures, there is no reason to believe that, in the absence of other external factors, there would have been any significant change in the protein crop area as a result of the reform. This is because the 2003 measures replaced coupled area payments linked to reference yields under the regionalisation plans of each EU-15 MS with a uniform special aid of €55.57 per hectare for protein crops.

It has been stated that the €55.57 was calculated as the weighted average difference between the coupled area payments on protein crops and those on "other cereals" in the EU-15 MS. The coupled payments previously paid on cereal and oilseed crops were replaced by decoupled aids under the SPS, which applied in full to protein crop producers.

The implication of this reform was that the average protein crop producer in the EU-15 MS would have experienced no change in their full income per hectare, *ceteris paribus*, as a result of the reform. As such, the 2003 reform would not have been expected, on average, to have changed the protein crop areas in the EU-15, all of which had implemented the SPS by 2006.

Two EU-12 MS, Malta and Slovenia, applied the SPS on accession, the other ten adopting the SAPS, among whom Hungary will apply the SPS from January 2010. Only two of the EU-12 (Lithuania and Slovenia) opted to apply a specific CNDP payment on protein crops alone. Several others incorporated protein crops within a broader CNDP payment for a number of arable crops, which included the main COP crop alternatives for farmers, thereby avoiding any specific incentives for protein crops. Thus, the measures in the protein crop sector would again have been expected to have had a very minor impact, *ceteris paribus*, on EU-12 areas.

The major determinants of the changes in planted areas that followed the reform lay outside the sector. They included world market price developments among arable crops; the damage caused by the *aphanomyces* fungus in Northern France, the most important single protein crop growing region in the Community; the ban imposed on the use of meat and bone meal in most feed applications from 2001 onwards, which removed a major complement for protein crops in feed compounding; the CAP energy crop measures which encouraged the cultivation of rapeseed for biofuel output, and which had a dual impact on protein crops, not only harming the demand for protein crops for feed, by generating increased supplies of an alternative – and higher protein – feed (rapeseed meal) for compounders, but also by allowing rapeseed to take the place of protein crops in the rotations practised by cereal farmers.

Thus, the decline of the protein crop areas is not attributable to the measures introduced in the sector by the 2003 reform.

Analysis of the impact of CAP energy crop measures and ending special aids for grain legumes revealed that neither explained the changes in protein crop areas satisfactorily.

The Maximum Guaranteed Area established in the reform was never reached. Consequently, the MGA component of the 2003 reform had no impact on protein crop areas.

1.1.2. Effects of the 2003 reform on the geographical distribution of output

Changes in protein crop areas differed between the EU-15 and EU-12, comparing 2000-2003 with 2004-2008. In the EU-15 MS, both field pea and sweet lupin areas fell substantially; while field bean areas increased. In the EU-12 MS, both field pea and field bean areas declined, while the sweet lupin areas almost trebled (admittedly from a low base), and this was enough to generate an increase in the overall protein crop area in the EU-12.

The application of a uniform coupled aid of €55.57 per hectare following the 2003 protein crop measures would have been expected to have had a minor impact upon the geographical distribution of protein crop areas within the EU-15. it would have created some incentive to expand protein crop areas in regions with lower than average reference yields (as the uniform special aid was higher than the difference between protein crop and cereal coupled aids before the 2003 reform) and conversely a minor incentive to reduce protein crop areas in regions of above-average reference yields.

Because regions with low reference yields under the measures in effect until 2003, such as one case study region, Castilla-La Mancha in Spain, tended to have low gross margins at market prices and low benefits from crop rotations (as their cereal crop yields were also low), the measures introduced from 2004 had a significant impact on their incomes per hectare, when contrasted with those in effect until 2003. Table EQ3.21 reveals that in only six of the EU-15 MS was the net effect of the 2003 reform on the difference between coupled revenues on protein crops and those on other COP crops in excess of €10 per hectare. However, these were all MS with low yields. In Castilla-La Mancha, the net gain following the reform was over €28 per hectare, which was a very significant sum in relation to the full net advantage of €32 per hectare for field peas over other COP crops in 2006-2007, as described in Table EQ3.15.

This helps to explain why Spain, alone among the major field pea producing MS in the EU-15, recorded substantial growth in its field pea areas in 2004-2008, in relation to 2001-2003.

Overall, the analysis provided some evidence, but not strong enough evidence to have any statistical significance, that there was a slight change in the geographical distribution of output towards lower yielding regions. To the extent that this occurred, it would have been a consequence of the nature of the reform, although the net effect on overall planted areas would depend on the sensitivity of producers in different regions to small changes in incentives, both upwards and downwards.

1.1.3. Effects of the 2003 reform on protein crop yields

Protein crop yields as a whole declined after 2003. Field peas suffered the largest decline, followed by sweet lupins, while yields of field beans remained fairly stable. Part of this decline can be explained by external factors, such as the incidence of *aphanomyces* and unfavourable weather conditions. The hypothesis that, after the 2003 reform, farmers reduced their input use was not supported by the results of the farmers' survey; moreover, there was no reason to believe that the measures introduced in 2003 would have had any such effect.

The decline in the overall level of protein crop yields can also be explained to some extent by a shift in the geographical distribution of protein crop area away from regions with above-average reference yields to those with below-average reference yields. Regression analysis was used to test this hypothesis, but the evidence to support this conclusion is not statistically significant.

1.1.4. Effects of the 2003 reform on protein crop output

The decline in protein crop areas in the EU-27 after 2003 and poorer yields led to a fall in output. In 2000-2003, protein crop output was stable in the region of 4.3 million tonnes, but it fell to 3.6 million tonnes in 2004-2007, a decline of 15%. Individual protein crops witnessed different trends: field pea production led total output down, but the production of both field beans and sweet lupins rose in the EU-27.

While it is evident that output fell after the 2003 reform, the lack of clear evidence linking the changes in the measures brought about by the 2003 reform to the declines in areas and yields means that we cannot establish a causal relationship between the effects of the 2003 reform and changes in protein crop output.

1.1.5. Effects of the 2003 reform on the structure of protein crop farming

Analysis of the FADN sample of protein crop producers revealed that protein crops tend to be cultivated mainly on the largest holdings. On average, only a small fraction, typically less of 10%, of total farm area is devoted to these crops.

There is no evidence that the measures introduced in the 2003 reform led to a change in the structure of protein crop farming; however, FADN data are not available after 2006, and thus they included only one year in which the SPS was fully implemented in all EU-15 MS, which limits the ability to discern changes in structure as a result of the 2003 CAP measures.

1.1.6. Effects of the 2003 reform on protein crop prices

Over the evaluation period, internal prices of protein crops have tracked world market quotations of protein crops, which is not unexpected, in view of the minimal (and for field peas, zero) import tariffs on protein crops. Most of the output of all three crops is used for feed, but for both field peas and field beans a significant minority of production receives premium prices in food uses. These price dynamics pre-dated the 2003 reform and have not been affected by the introduction of the measures.

1.2. EQ2: Impact on the supply to the compound feed industry

EQ2 To what extent have the CAP measures applicable to the protein crop sector influenced the supplies to the compound feed industry, with regard to crop (beans, peas, sweet lupins); quantity; prices; geographical distribution?

To what extent have these supplies corresponded to the plant protein needs of the compound feed industry and influenced substitution with other plant protein sources?

There has been a sharp decline in demand from the compound feed sector for protein crops over the evaluation period. In view of the simultaneity inherent in the sector, it is not possible to identify whether weak demand forced local output down, or *vice versa*. What is clear is that, at the prices that the feed sector was willing to pay for protein crops, many producers were not wiling to maintain their production.

Not all feed end-uses have been equally hard hit. On-farm feed has suffered less than commercial compounding, especially in the EU-12. Also, there is some evidence that protein crops have secured a niche in two feed market segments: non-GMO feeds (a sector from which the most important protein feed, soybean meal, is largely excluded) and organic feeds, where on-farm feed uses favour protein ingredients grown on the same holding. The experience regarding the development of organic protein crop production is not uniform (French organic production has fallen as a share of the total, but increased in Germany).

Other outlets that have been better maintained during the decline have been in premium human and pet foods, the former destined primarily for export for food uses, the field beans going mainly to North Africa and the field peas to South Asia. It is undoubtedly significant that the growth in field pea production in Canada, the world's leading producer, has been heavily dependent on the import demand from South Asia.

1.2.1. Effects of the 2003 reform on the changes in quantity and type of protein crops purchased by the feed compounding industry.

The decline in protein crop output after 2004 reduced the domestic supply of these crops for the feed industry. At the same time, however, other factors, unrelated to the CAP policy framework, some pre-dating the 2003 reform, harmed the demand for protein crops.

One of these factors was the ban of the use of meat and bone meal (MBM) in many feed applications in 2001, as a result of BSE. MBM is a high protein feed, and was commonly used to complement protein crops (whose protein content is relatively low) in mixed feeds. Another factor, equally important, was the ease with which soybean meal supplies were able to fill the gap in demand for ingredients with a high protein content.

A third factor has been the reduction in cereal intervention prices since the 1990s, which encouraged users to mix feed wheat with soybean meal and produce a competitively priced product with a very similar amino-acid composition to field peas. A fourth factor, particularly evident since 2004, was the strong increase in the supply of rapeseed meal, in part as a by-product of biodiesel processing in response to CAP energy crop measures. Its protein content is higher than that for protein crops, and thus it is attractive to feed compounders.

The interaction of all these elements on the availability of supply to the feed compounding industry means that it is not possible to establish a causal link between changes in the 2003 specific CAP protein crop measures and the reduced use of protein crops as feed ingredients. What is certain is that the ready availability of alternative protein inputs at competitive prices meant that, in general, the large scale feed compounding sector was not at all significantly affected by the decline in domestic protein crop supplies.

We conclude that the decline in protein crop use in feed compounding was not caused by the 2003 protein crop reform measures.

1.2.2. Effects of the 2003 reform on the geographical distribution of supply

Since the 1990s, there has been a steady migration of feed compounding plants away from traditional crop production centres to areas near ports, where supplies of imported feed ingredients can easily be obtained. At the same time, the industry has undergone a process of consolidation, and the unit costs of handling reduced supplies of protein crops have risen. These factors have created a vicious circle that discourages the feed demand for protein crops, and hence raises their unit handling costs further. There is no evidence that the 2003 reform played any part in determining the pace or extent of the structural changes affecting the feed compounding sector.

At the same time, the geographical distribution of apparent protein crop consumption of feed uses has mirrored the evolution of output by MS. Among the leading producing MS, apparent consumption increased substantially in the period 2004-2007 only in Spain. Other major producers among MS experienced significant reductions in their consumption.

1.2.3. Effects of the 2003 reform on prices paid by the feed compounding sector

Feed compounders are willing to incorporate protein crops into their mixtures at the price they consider reasonable. In this respect the close correlation observed since 1993 between field pea prices and a weighted average of feed wheat and soybean meal prices, a mixture that can substitute for field peas, implies that field peas have remained competitively priced.

In food uses, the premium for yellow pea over lower quality field peas used in feed is determined by net import demand for yellow peas into the Indian sub-continent.

We conclude that the key determinants of protein crop prices are market factors (prices of alternative protein feed inputs and demand for protein crops for food in the export market) and that the 2003 policy measures have had no impact on the purchase prices paid by the feed compounding industry. Other CAP measures, notably the energy crop measures, have been much more important causes of the price trends seen in the protein feed sector.

While the purchase price of protein crops is considered to be reasonable, the supply of protein crops affects compounders' willingness to use them. "Critical mass" is a phrase often used in discussion of the sector. Compounders and traders mention it when discussing their concerns about the future of these crops. This is because they need to maintain separate *filières* for protein crops, with dedicated storage capacities. The decline that has occurred in the volumes available locally has increased the unit transactions costs of using these inputs. These higher costs deter compounders from incorporating them into their formulations.

1.3. EQ3: Competitiveness of protein crops

EQ3 To what extent have the CAP measures applicable to the protein crop sector contributed to fostering the competitiveness and promoting the market orientation of protein crop production?

The relative competitiveness of protein crop production vs. alternatives will be analysed pre-reform; post-reform; and with full decoupling, including associated production responses.

1.3.1. The effects of the 2003 reform on the competitiveness of protein crops

In terms of profitability, analysis of gross margins and incomes per hectare in selected regions revealed that protein crops were at a disadvantage to competing COP crops both in 2000-2003 and in 2006-2007, after the full implementation of the SPS in all EU-15 MS. In the latter period, their competitiveness worsened in six of seven region-crop permutations covered in the evaluation, despite improved benefits from crop rotation in those years. The sole exception was the lowest yielding region among the case studies, Castilla-La Mancha, Spain.

Protein crops also fared worse than most other COP crops in terms of risk in their full gross margin (as measured by the coefficient of variation from 2000 to 2007).

The lack of uniformity between the experience of Castilla-La Mancha and that of the other four case study regions (Seine Maritime and Eure et Loir, France; Niedersachsen, Germany: and East Anglia, UK), when analysed from the perspective of the competitiveness of protein crops against other COP crops, suggests that the 2003 protein crop measures had an impact upon the geographical distribution of output within the EU-15 MS. However, this is not supported by statistically significant results from the analysis of area changes.

We deduce, therefore, that neither in terms of risk, nor in terms of changes in profitability, can the decline in competitiveness of the protein crop sector be attributed conclusively to the protein crop measures in the 2003 reform.

Protein crops have also lost competitiveness since 2003 in their share of feed demand. As noted already, the main reasons for this decline are external, such as the meat and bone meal ban; the greater availability of alternative protein feed ingredients; the *aphanomyces* fungus that affects a significant proportion of field pea areas in France; etc. Together, these influences, none of them part of the 2003 measures in the protein crop sector, created a vicious circle; the declines in output fed on themselves. Traders and feed companies found the unit costs of handling smaller volumes of protein crops rising, and so turned away from them. In the meantime, seed and chemical companies reduced research in the sector, and this is likely to have lasting effects upon its agronomic competitiveness.

We analysed the counterfactual case of full decoupling. Since this would lower the full income per hectare from protein crops, it would be expected to reduce the areas planted to protein crops. Simulations were undertaken of the impact of full decoupling, using the results of the farmers' questionnaires and two alternative linear econometric analyses of the relationship between the profitability of protein crop production and changes in planted areas.

It should be stressed that the conclusions need to be interpreted with caution. The sample of farmers who answered the questionnaire is not necessarily truly representative of the sector. Also, the statistical significance of the linear regression analyses was too low to be accepted as a sound basis for conclusions. With this qualification in mind, we note that the different approaches implied that full decoupling would reduce the protein crop areas by between 2.9% and 8.6% below 2008/09 areas.

1.3.2. Effects of other CAP reforms on the protein crop sector

A simulation was undertaken to determine whether changes in the broader CAP framework, in the form of reduced intervention prices and changes in coupled payments, acted to discourage production of field peas vis-à-vis common wheat across the EU-15. The analysis, which included consideration of the impact of world market price fluctuations, indicated that higher yielding regions of the EU-15 would have found field pea production for feed compounders increasingly uncompetitive after 2001. The same simulation suggested that lower yielding regions started to find field peas unattractive only after 2003. These results are in line with the observed evolution of production.

1.3.3. Effects of the 2003 reform on the market orientation of protein crops

Barriers to trade in protein crops are virtually non-existent. As a result, local protein crop prices should be aligned with world market prices. While world market price dynamics changed after 2004, there are no indications that the reform affected the market orientation of the sector.

1.3.4 Investment in new seed varieties

The declining output from the sector means that the number of seed companies for whom protein crops represent a viable area of investment has declined significantly. This issue is further accentuated by producers retaining seed for their own use. Many seed companies state that the sector is ceasing to be large enough to warrant a major research effort.

Although the introduction of erect varieties of field peas, and of more resilient varieties that could be planted in winter, as well as varieties resistant to *aphanomyces*, could revive producers' interest in these crops, cutbacks in research due to shrinking local demand for seeds are slowing the pace of innovation.

Field beans have benefited from the development of erect varieties, which has made them more attractive to producers. Demand for sweet lupin seeds seems less sensitive to yield trends, since they are mainly used on-farm, and are grown in some regions (notably Poland) in mixtures with cereals.

1.4. EQ4: Maintenance of farmers' incomes

EQ4 To what extent have the CAP measures applicable to the protein crop sector contributed to maintaining/increasing farmers' incomes?

1.4.1. The effects of the 2003 reform on the income of protein crop producers

Producers' full incomes per hectare comprise gross margins at market prices; rotational benefits; coupled aids; and decoupled aids.

After full adoption of the SPS system in 2006, the contribution of coupled payments to income fell considerably in the regions surveyed, with the decline less severe for farmers in France and Spain, as these MS chose to retain 25% of their COP coupled arable aid as a coupled aid. At the same time, the introduction of the decoupled aid offset a great deal of the fall in the coupled support. In 2006-2007, the combined value of coupled and decoupled payments per hectare of protein crops was somewhat lower than the (entirely coupled) support received in 2001-2003 in six out of the seven combinations of regions/protein crops covered in our assessment. Castilla-La Mancha's production of field peas was the sole exception.

The value of the rotational benefits, which are fully acknowledged by producers, has risen since the reform, as a result of the higher market price of nitrogenous fertilisers and higher prices of cereals, which benefit from a yield increase when they follow protein crops in a rotation. These rotational benefits are greater than those for other break crops (notably oilseeds) in a mainly cereal-based farming system.

In terms of direct costs per hectare, the competitiveness of protein crops benefited in recent years from their lower fertiliser use; but they suffered a loss of competitiveness in terms of full income per hectare. This is partly a consequence of their poor yield trends, but is also the result of higher market prices for all major crops since the reform.

Analysis of incomes reveals that, since 2003, protein crop producers' full incomes were not maintained or increased as successfully as the full incomes earned per hectare of other COP crops in a consistent fashion across the MS, but the causes were not related to the specific protein crop aids introduced in the 2003 reform.

The following conclusions can be drawn:

Gross margins at market prices depend upon changes in prices, yields and direct costs. None of these is affected by measures introduced by the 2003 reform in the protein crop sector.

Rotational benefits depend upon yields and prices of the cereal crop following protein crops in a rotation. Again, these were not affected by the CAP protein crop measures.

Coupled aids were reduced in value per hectare. In the case of the protein crop measures, as explained earlier, the level of the uniform coupled aid per hectare was stated to have been calculated in such a manner as to leave an average EU-15 protein crop producer's difference between coupled aids on protein and other COP crops totally unchanged by the reform. There would, however, have been a slight incentive created for producers in lower yielding areas, and disincentive for those in higher yielding areas.

The decoupled aids are a key element of the broad CAP reform, and were not specific to the protein crop sector, and do not affect at all the choice of crop.

It emerges therefore that, other than through a possible small redistribution of incentives between high and low yielding regions, protein crop farmers' incomes since the 2003 reform have been determined wholly by external factors, not by the reform.

1.5. EQ5: Efficiency in achieving the objectives of the measures

EQ5 To what extent are the CAP measures applicable to the protein crop sector after the 2003 reform efficient in achieving the objectives of these measures?

1.5.1. The extent to which the objectives of the reform were achieved with a reasonable use of resources

The 2003 reform lowered the cost of coupled aids to the CAP budget, but the savings in budgetary costs were shifted mainly to decoupled aids, and were not tied to protein crops.

Despite the introduction of decoupled aids, the aggregate level of support per hectare for protein crop farmers is slightly less in six of the seven regions surveyed than the support they received before the 2003 reform. The only region among those surveyed where total support per hectare increased was Castilla-La Mancha.

Since the combined coupled and decoupled payments per hectare were not much altered after the reform, the reform can be said to have continued to provide an important measure of stability to the incomes of protein crop farmers.

As noted earlier, the major factors behind the decline in protein crop output, and hence its apparent agricultural competitiveness, lay outside the protein crop sector, and cannot be attributed to the 2003 measures.

1.5.2. Deadweight

Regarding the deadweight, the analysis suggests that there was no deadweight in the measures, since the outcome would not have been exactly the same in the absence of all special aids. In order to assess how cost-effective the measures are in budgetary terms in maintaining protein crop production, we applied the results of the producer questionnaires and the two linear regression analyses mentioned in 1.3.1 above to assess the impact on area of the elimination of coupled aids. These three approaches (none of which has statistical significance) were used to estimate the net budgetary cost of maintaining one marginal hectare of protein crop output. The analysis indicated that €650-€1,950 per hectare was the effective cost, which suggests inefficiency in the measures.

1.5.3. Unintended side effects

As stated earlier, our analysis of the geographical distribution of protein crop production provided weak evidence to support the hypothesis that the measures provide limited encouragement to expand protein crop production in regions with a low reference yield, while discouraging in a slight way production in regions with higher than average reference yields. This is interpreted as an unintended side effect of the 2003 measures. Under the Health Check reform, this particular unintended consequence of the measures as they apply to all EU-15 MS will be removed, since the €55.57 coupled payments will cease by 2012. However, individual MS enjoy discretion over the use of funds to retain an element of coupled aid under Article 68 Reg. 73/2009 measures and to apply partial decoupling under Article 63.

1.5.4. Simplification of the administrative measures

Our analysis provides no indication that the 2003 reform caused an additional administrative burden for producers or government agencies. For both groups, the administrative workload associated with measures applied in the protein crop sector is a very small element of the overall administration required by the CAP and the CAP payments to farmers. No changes were noted in the administrative burden after the implementation of the 2003 reform.

1.6. EQ6: Coherence of the measures with the 2003 reform of the CAP

EQ6 To what extent are the CAP measures applicable to the protein crop sector after the 2003 changes coherent with the overall concept and principles of the 2003 reform of the CAP?

1.6.1. Economic sustainability of the sector

In terms of competitiveness with non-EU supplies, our preceding analysis indicated that the EU market for protein crops is very open and that foreign trade, both inwards and outwards, plays a key role in the supply and demand balance for these crops. This openness was not affected by the 2003 measures.

From the perspective of the competiveness vs. alternative COP crops, this worsened in most regions after the 2003 reform, even allowing for increased benefits from externalities for the following crop. This was due to adverse external factors, and cannot be attributed to the specific protein crop measures.

With regard to protein crop use by feed compounders, exogenous factors, such as the bans on meat and bone meal in most feed uses in 2001 and increased supplies of rapeseed meal as a result of CAP energy crop measures, have weakened the competitiveness of protein crops.

There is no evidence that the 2003 measures played any role in the decline in protein crop use by the feed industry.

At the same time, there are some bright spots. There has been a relative increase (relative to the rest of the sector) in the economic competitiveness of protein crop production in three specific outlets: the development of organic production; the use of protein crops for on-farm feed (with associated environmental benefits from reduced “feed-miles” in the supply of inputs); and the production of high quality, premium-priced protein crops, for third country export markets for food, and also for pet food.

The development of these outlets was unrelated, however, to the 2003 measures.

1.6.2. Social sustainability of the sector

At farm level, the labour required by protein crop production is a very small percentage of total labour use on protein crop farms. In feed compounding, too, protein crops only account for a very small share of inputs. At the same time, the industry has been undergoing a consolidation process which started prior to the 2003 reform.

We conclude, therefore, that the 2003 reforms have not affected the social sustainability of the sector.

1.6.3. Environmental sustainability of the sector

Protein crop production generates valuable externalities for following crops. These arise in other sectors, i.e., cereal farming, rather than the protein crop sector itself. Therefore, the sector contributes to the wider environmental sustainability of EU agriculture.

Within the protein sector itself, analysis of the use of inputs within the sample of protein crop producers who completed the questionnaires revealed no evidence of a systematic change in input use by protein crop producers in the EU between 2003 and 2008.

In Germany, there has been an increase in the share of the area of protein crops farmed organically in the last few years (though in absolute terms it declined), but the share of organic protein crop production declined in France. Consequently, the evidence regarding the adoption of organic farming methods, with environmental benefits, is mixed.

The producer questionnaires revealed that a significant minority of producers felt that agri-environmental payments were an important factor in their decision to cultivate protein crops, but such measures targeted specifically towards environmental benefits are part of other aspects of the CAP reform, and are not part of the 2003 protein crop measures.

The reform directed solely towards protein crop producers should not have influenced in any way changes in protein crop areas on environmental grounds.

1.7. EQ7: Correspondence to the needs of producers and users

EQ7 How far do the objectives of the CAP reform correspond to the needs of producers and those of the compound feed industry and livestock farmers?

1.7.1. Effects of the 2003 reform on fair living standards for producers

Within the protein crop sector, there was no uniformity in the changes in producers' full incomes per hectare after the 2003 reform; what did emerge from the analysis was that, judged in terms of average full incomes per hectare, protein crops have lost competitiveness against other COP crops in recent years.

Yet again, it must be stressed that these outcomes are not the result of the 2003 reform measures, whose net impact in terms of changes in producers' incomes as a result of the reform was minimal, and were largely confined to the limited element of *de facto* redistribution between higher and lower yielding regions in payments per hectare.

1.7.2. Effects of the 2003 measures on meeting the needs of users

The discussion of EQ2 highlighted the way in which the need for protein crops by feed compounders has declined over the evaluation period, due to the greater availability of alternative feed ingredients with a higher protein content and the banning of meat and bone meal use in most applications. Thus, the decline in protein crop use was unrelated to the measures introduced in the sector in 2003.

1.7.3. Effects of the 2003 measures on reasonable prices for consumers

Internal market prices are closely aligned with those in the international market, thanks to the virtual absence of trade barriers. This ensures that prices for protein crops are reasonable. Because this trend pre-dated the 2003 measures and was not altered by changes in the measures, we conclude that the 2003 reform maintained reasonable prices for consumers.

1.7.4. Relevance of the 2003 measures in the protein crop sector

The 2003 measures were relevant to producers in two main respects, in helping to maintain producer incomes per hectare after the reform, and in continuing to provide an important element of stabilisation to producer incomes.

The measures were not the cause of the general loss of competitiveness in production for protein crops vs. other COP crops after the reform.

For users (feed compounders and livestock farmers), the measures continued to keep domestic market prices of protein crops closely linked to world market prices. Thus, users remained free to formulate their feeds in line with free market relativities, and were able to benefit from greater availability of other protein inputs, such as rapeseed meal, in response to other CAP measures, such as the energy crop measures.

1.8. Overall conclusion

A major overall conclusion is that the sector's decline and loss of competitiveness (in terms of profitability vs. alternative COP crops and declining interest in the use of protein crops by feed compounders) were not a result of the 2003 measures, but were due to external factors.

This decline in the sector's overall size, most notably in field peas, is creating a loss of critical mass in the *filière*.

Seed companies are cutting back their investments in protein crop research and development; the same is true of agri-chemical companies; in addition, traders are less willing to operate a supply chain for a product whose importance is decreasing, raising their unit transaction costs for protein crops; and some producers are displaying a lack of confidence in the future prospects of the sector.

Not all is bleak. The decline has been led by field peas and by the EU-15 MS.

The experience in the EU-12 has been more encouraging, with an increase in total protein crop areas since 2004, led by sweet lupins, which are favoured for on-farm feed use, an increasingly important issue as traceability becomes a greater concern on the part of users.

In the EU-15, field beans have been a growth sector, helped by the development of erect varieties that make harvesting simpler, and by the existence of stable high value export markets for food uses.

In general, three sectors appear well placed for the future: production for food markets, particularly in third countries; on-farm feed use, to benefit from worries about traceability; and organic production.

2. Recommendations

Falling output of protein crops for bulk feed uses will continue, unless agronomic constraints can be overcome. The need for improved varieties is a top priority if the sector is to survive and eventually revive. We believe that an increase in spending on research is crucial, to enhance the technical competitiveness of the sector vs. other COP crops.

A further recommendation is to learn from Canada's success in premium-priced protein crop exports, by promoting sales to human and pet food markets.

Art. 68, Ch. 5 in the Health Check reform, Reg. 73/2009, allows MS to grant specific support to farmers in particular to address environmental and welfare issues and improve the quality and marketing of agricultural products, including protein crops. This opportunity should be actively encouraged.