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Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture

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Organic farming: implications for costs of production and provisioning of environmental services

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Executive Summary

The overall aim of this report is to contrast organic and conventional forms of commodity production in terms of costs and environmental performance. Specific objectives are to apply the General Cost of Production Model (GECOM) developed in the FACEPA project to organic farms, to compare GECOM results for organic farming to data from other national studies as part of a (quasi-)validation, to discuss production costs in organic farming in the light of the structure of the organic farming sector and the respective policy environment in selected EU Member States, and to explore the potential of FADN systems for deriving environmental impacts at farm level, calculating and comparing selected indicators for organic farms.

The report is structured as follows: First, a short overview is given of the structure of the organic farming sector and the respective policy environment in selected study countries (Chapter 2). Chapter 3 provides a description and discussion of production costs in organic farming collected from various other national sources, paying specific attention to the impact of different methodological approaches used in the available studies. In Chapter 4, the GECOM estimations for fully organic farms of EU FADN are illustrated and compared to other national production cost data to provide a quasi-validation of the GECOM estimates. Chapter 5 presents a comparison of the GECOM estimates for production costs in organic and conventional farming. The final Chapter 6 then illustrates the potential of identifying environmental impacts based on FADN data

Farm structure and policy environment may potentially influence the costs of production for organic crop and livestock enterprises. Based on a review of existing data and studies, a short overview of the structure of organic farms and the organic market, national and/or regional policy as well as the certification system is given for the study countries Austria, Denmark, Germany, France, Italy, the Netherlands, Poland, Sweden and the UK.

In most countries, but especially in Germany and Italy, large regional differences in farm structure and production systems in organic farming suggest that average figures may not give an overall picture and that figures broken down by region may give a more accurate impression of the cost structures for organic farming. In the Netherlands and the UK, the predominance of larger farms in the northern regions of the respective country may impact on costs as these farms may be able to make use of economies of scale to reduce costs. The maturity and structure of the market differs between countries (e.g., the Danish market is characterized as more mature, whereas the market in Poland is less developed due to the small size of organic farms and lack of producer groups), which may have an impact on revenues as well as marketing costs for farmers.

In many countries, private organic standards play an important role, and these may affect costs if they differ to the EU organic regulation. In several countries (Denmark, France, Netherlands, the UK, Sweden) these private standards with regard to livestock feed and housing are likely to increase respective costs. Other examples identified include social standards in the Italian Organic Standards which may have an impact on labour costs, and additional environmental requirements for organic farms in Poland. On the other hand, in some cases derogations from the EU regulation may reduce costs (e.g., a derogation for conventional seed in Poland in 2006). In some countries, certification is subsidised or covered by the state (e.g., Denmark), which reduces costs for farmers accordingly.

The availability of data from existing studies on production costs in organic farming for validation purposes is very limited. Information was therefore collected for selected study countries from national experts. Still, the challenges experienced during the collection and processing of cost data from other sources for conventional farming were amplified for organic farming not only due to even fewer sources being available, but also due to the greater importance of methodological issues concerning the treatment of farm-produced production factors and stronger interlinkages between all farm processes. These limitations need to be taken into account when interpreting and using the collected cost data.

The GECOM model was applied to the EU as well as the German national FADN. In the EU-FADN, a variable identifying organic farms is included since 2000, however only a few countries (Austria, Germany, Denmark, The United Kingdom, France, Italy, Poland, and Sweden) have a data set for organic farms which is big enough for analysis. Only for Austria and Germany is the organic sample big enough for all of the years from 2000-2007, while in most other countries samples are often small in the period 2000-2003. However, the data availability for these countries increases from 2004 onwards. FADN data for the new member state Poland have been included since the country joined the EU in 2004. To increase robustness of results and facilitate interpretation, GECOM estimates have been averaged over the time period where samples were big enough for econometric estimations

Generally, the production cost estimates for organic milk match the reference data very well, with respect to absolute values as well as with respect to cost structures. Estimated production costs I (excluding cost of labour, land and capital) range from 200 to 300 €/t of organic milk in most of the countries analysed, with Germany having the highest costs (340 €/t) and Poland showing the lowest costs (110 €/t).

In Austria and France, cost of milk production are only slightly higher in organic compared to conventional farming, and costs structures of the two farming systems are very similar. In Denmark, Germany, Italy and Sweden, production costs for organic milk are significantly higher than for conventional milk. This is due to higher feed costs (especially for Italy) and, in the case of Germany, higher miscellaneous costs. In Poland, estimated costs of milk production is lower in organic farming than in conventional farming which might be caused by very extensive organic production systems, and the rather high feed costs in conventional farms. The general relations between organic and conventional production costs remain the same when including the costs for labour, land and capital (production costs II, full costs), however the gap to conventional farming increases in Italy (due to higher labour costs), Poland and Sweden (due to higher capital costs) and especially in the case of Germany (due to higher costs for all three factors). Estimated full costs in the old member states range from 350 €/t (France) to 490 €/t (Germany). With the exception of Poland, the market price for organic milk is higher than for conventional milk in all of the countries. The estimates indicate highest subsidies per tonne of milk in Austria and lowest in France and Denmark. Total returns and subsidies cover total costs only in France, Poland and Italy.

For wheat, the level and structure of estimated costs and the cost information from other sources match well only for Denmark. The differences for the other countries are partly due to remaining intractable differences in cost aggregation and methodological approaches, however may also be due to the fact that GECOM results for crop products are often less robust.

Estimated production cost for organic wheat are about 200 €/t for Denmark, France and Sweden and 350 €/t for Germany. The costs are thus significantly higher than in conventional farms (90-110 €/t). The difference is highest in Germany due to rather high miscellaneous costs in organic farms, but also due to higher depreciation, seed and maintenance costs than in most other countries. With the exception of the cost categories "fertilizer" and "crop protection", all cost categories in organic wheat production exceed those of conventional production. Costs for labour, land and capital in organic wheat production vary significantly between countries, and range from 90 €/t in France to 400 €/t in Denmark. While estimated production costs II of conventional wheat are in the range of 160 to 210 €/t, those of organic wheat range from 280 to 590 €/t.

For potatoes, production costs were estimated for Austria, Germany and Sweden, but differed significantly from the information gathered from other sources. Estimated production costs I of organic potatoes were 140 €/t Euro per ton for Sweden, 175 €/t for Austria and 210 €/t for Germany, compared to production costs of conventional potatoes ranging between 50 and 75 €/t. High prices and allocated subsidies are higher than full costs in Germany and Austria, but not in Sweden.

Estimated production costs I for cattle are higher in organic compared to conventional farming in all countries with the exception of Denmark. Production costs I for organic cattle range from 200 € per livestock unit in Denmark to 500 Euro € per livestock unit in Germany, whereas for conventional cattle it is around 300 Euro € per livestock unit in all countries. Germany shows a comparatively high level of production costs I for organic cattle, while conventional production costs in Germany are the lowest of all six countries analysed. Full costs for organic cattle are highest in Austria, while allocated subsidies are highest in France and Austria. Only in France, full costs of organic cattle are covered by revenues plus subsidies.

For a more detailed analysis of production costs for organic wheat and milk, the GECOM model is applied to German national FADN data from 2000 to 2009. To increase the robustness of results, a statistical method for outlier detection was used. An above average rate of outliers was detected for field crop farms, large farms and legal farms (corporate farms). The improvements from the removal of outliers was most obvious for milk, as estimated production costs were much less volatile over years. Production costs as well as returns of wheat are much higher for organic farms than for conventional farms. Conventional farms show much higher costs for fertilizer and crop protection, whereas organic farms have very high costs for contract work and depreciation, and a higher net value added. Production costs as well as returns for organic milk are about 50 €/t higher than those of conventional farms. Organic farms have much higher costs for home-grown feed and slightly higher costs for purchased feed and depreciation, and a slightly higher net value added than conventional farms. The results also indicate a cost advantage of farms which are specialised in organic milk production compared to more mixed farm types.

In this report the possibility is investigated of using farm economic data to provide environmental indicators on which farms can be assessed. A selection of environmental indicators was made based upon previous research. These assess the level of inputs (fertiliser, crop protection, purchased feed), intensity of the agriculture (intensification indicator, LUs per forage area), participation in agri-environmental activities (monetary receipts from agri-environmental schemes), diversity of cropping (Shannon index), and availability of wildlife habitats (proportion of land that is permanent grassland, woodland, or fallow). These indicators were investigated using Farm Business Survey data for England and Wales from 2008-09 and 2009-10.

A selection of indicators was used to compare organic and conventional farms across robust farm types using FBS data. Each indicator was assessed across all farms within the survey and across all organic and all conventional farms. The indicators were then calculated for each farm type and the split of these into organic and conventional.

The results showed that there are statistically significant differences between organic and conventional farms in terms of fertiliser cost, crop protection cost, intensification, and agri-environment scheme payments. These results suggest that organic farms are less intensive with lower fertiliser and crop protection use and tend to be involved in more agri-environment schemes than conventional farms. In contrast there is no significant difference between organic and conventional farms with regards to crop diversity except for mixed and lowland grazing livestock farms where organic farms have a statistically significantly lower diversity. There is also no significant difference between organic and conventional farms in terms of the proportion of land that is woodland, permanent grass or fallow except for general cropping farms where organic farms generally have a higher proportion.

With regards to purchased feed costs and livestock stocking densities, whether there is a significant difference between organic and conventional farms depends on the robust farm type. Purchased feed and purchased concentrate costs for dairy farms only show differences of low statistical significance with organic farms having slightly higher costs per livestock unit (possibly due to higher organic feed prices rather than higher usage). For lowland grazing livestock there is a more strongly significant difference with organic farms having lower purchased feed costs. This is also reflected in LFA grazing livestock farms although with a slightly lower significance. In general purchased feed or concentrate costs are not significantly different between conventional and organic mixed farms. Dairy and lowland grazing livestock farms show significant differences in stocking density between organic and conventional management with organic farms tending to have lower stocking densities. The difference for LFA grazing livestock farms is only significant at the 5% level, perhaps reflecting the fact that such farms tend to be unable to support larger stocking densities regardless of management system.

In general it appears from the analysis that organic farms are less intensive than conventional farms, however organic farms appear to have less cropping (and potentially less habitat) variety as reflected by some of the Shannon index results. It would also appear that grazing livestock farms in general may be beneficial to the environment as assessed using this particular set of indicators.

It appears from the analysis presented here that it is possible to use economic data such as the FBS to provide some information on the environmental performance of farms and to compare this across different types if farms and farming systems. In particular it would be of great interest to combine some of the indicators into an overall score that took account of intensity, crop variation, variation in habitat and stocking rates, as well as agri-environment payments. Although an indirect measure of environmental performance may never achieve a perfect assessment a combined score could be weighted to reflect the relative importance of the various factors.

Contents

Abbreviations and Acronyms

EU	European Union
FACEPA	Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture
FADN	Farm Accountancy Data Network
GECOM	General cost of production model
ESU	European Size Units
UAA	Utilisable Arable Area

Input categories

FEEDPC:	Feed purchased
FEEDHC:	Feed homegrown
VETCOS:	Veterinary costs and other livestock specific costs
SEED:	Seeds (purchased and home grown)
FERTIL:	Fertilizer
CRPROT:	Crop protection
MOTFUE:	Motor fuel and lubricants
OENERG:	Electricity and heating fuels
CONWOR:	Contract work
BUILUK:	Upkeep buildings
MACHUK:	Upkeep machinery
OTHSIC:	Other costs (car expenses, other costs crops, forestry specific costs, water, insurance, other farming over heads and insurance of farm buildings)
LANDCO:	Land rent and taxes on land and buildings
INTERE:	Interest paid on all loans
DEPREC:	Depreciation
TAXES:	Taxes
SUBSID:	Subsidies
NETVAL:	Net value added

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1 Introduction

Work package 7 of the FACEPA project aims to characterise and to quantify the relationship between the costs of producing commodities across the EU and the impact which agricultural production exerts upon the landscape and natural environment (i.e., the multi-functionality of agriculture). This report will focus specifically on production costs and environmental impacts of organic farming. Organic farming constitutes a certified extensive production system which is supported under agri-environmental programmes in all EU Member States, and its importance for EU agriculture has increased strongly over the last decades, from 40,000 farms on less than 1 million ha in 1994 (Foster and Lampkin, 1999), to 260,000 farms on more than 9.3 million ha in 2009 (1.9% of EU-27 utilisable agricultural area; FiBL, 2011).

The overall objective of this paper is to contrast organic and conventional forms of commodity production in terms of costs and environmental performance. Specific attention will be given to methodological issues (e.g. data needs and availability; estimation; interpretation) of production cost estimation arising for extensive (i.e. non-average) technologies, using organic farming as an example. Specific objectives of this report are to

- apply the General Cost of Production Model (GECOM) developed in the FACEPA project (Surry, et al, forthcoming; Offermann and Kleinhanss, 2011) to organic farms,
- compare GECOM results for organic farming to data from other national studies as part of a (quasi-)validation,
- discuss production costs in organic farming in the light of the structure of the organic farming sector and the respective policy environment in selected EU Member States, and
- explore the potential of FADN systems for deriving environmental impacts at farm level, calculating and comparing selected indicators for organic farms.

The report is structured as follows: First, a short overview is given of the structure of the organic farming sector and the respective policy environment in selected study countries (Chapter 2). This is followed by a description and discussion of production costs in organic farming collected from various other national sources, paying specific attention to the impact of different methodological approaches used in the available studies. In Chapter 4, the GECOM estimations for fully organic farms of EU FADN are illustrated and compared to other national production cost data to provide a quasi-validation of the GECOM estimates. Specific attention is paid to the impact of the structure and policy environment for organic farming on production costs in the analysed countries. The next section presents a comparison of the GECOM estimates for production costs in organic and conventional farming. In addition to results based on the EU FADN, also findings based on time series data from the German national FADN are reported. The final Chapter 6 then illustrates the potential of identifying environmental impacts based on FADN data. Selected indicators are identified and tested for national data in the UK.

2 Structure and policy environment of organic farming in the study countries

2.1 Overview

The following section sets out some information about the farm structure and policy environment in the study countries that may potentially influence the costs of production for organic crop and livestock enterprises. Tables 2-1 to 2-8 summarise the information for each country facilitating country-by-country comparison. This is followed by a short description of the situation in each country.

Table 2-1 gives an overview of the structure of organic farming in each of the countries, based on two reports from the EU-CEE-OFP project (Lampkin et al 2007; Habralova et al 2005) supplemented by other sources of statistical data.

Tables 2-2 and 2-3 give an idea of the main products produced, drawn again from results of the EU-CEE-OFP project and a publication about the organic sector from the European Commission. As the data are drawn from two different sources some minor differences occur.

Table 2-4 gives an overview of the structure of the whole dairy industry. Please note that this refers to the whole dairy sector as specific data for organic dairy farms were not available for all of the countries. For the organic sector, a Eurostat publication (Rohner-Thielen, 2008) stated that in 2005 there were approximately 400,000 organic dairy cattle in the EU-27. German data were not included, however, and Germany is likely to contribute a further estimated 90,00 organic dairy cows. France, Denmark, and Italy had the largest numbers of organic dairy cows in the study and each accounted for approximately 15% of the total organic dairy herd cows (excluding Germany) (Rohner-Thielen, 2008).

Table 2-5 gives the share of organic production of cereals, potatoes and milk which was sold as “organic” in 2001 for each of the countries except Poland and Table 2-6 gives the farmer’s price for organic products in that year (Hamm and Gronefeld, 2004).

Table 2-7 shows the main certification systems in each of the countries as well as the number of public and private control bodies and standards, drawn from the certification and standards database ‘www.organicrules.org’. The information about the certification system refers to 2007 and is based on a survey carried out as part of the Certcost project (Jespersen 2011), the results of which are published on ‘www.organicRules.org’. The information about standard differences is based on the work carried out in Project ‘EEC 2092/91 (organic) Revision’ (No. SSPE-CT-2004-502397) which included the development of the database (www.oganicrules.org) and the analysis of the EEC Regulation No. 2092/91 in relation to other organic standards and their implementation (see Schmid et al., 2007). Table 2-8 shows the level of governmental support in each of the countries except Poland in 2001 (Hamm and Gronefeld, 2004).

Table 2-1: Certified in-conversion and fully organic agricultural land area (ha), share of national UAA (%) and average holding size (ha) by country.

Country	2000	2001	2002	2003	2004	2005	2006	2007
Germany	546,023	634,998	696,978	734,127	767,891	807,406	825,539	865,336
	3.2%	3.7%	4.1%	4.3%	4.5%	4.7%	4.8%	5.1%
	42.9	*43.2*	*44.6*	*44.6*	*46.3*	*47.4*	*47*	*46.3*
Italy	1,040,377	1,237,640	1,168,212	1,052,002	954,361	1,067,102	1,148,162	1,150,253
	8%	9.5%	8.9%	8%	7.3%	8.4%	9%	9.2%
	19.7	*22*	*22.9*	*23.9*	*26*	*28.9*	*25.6*	*25.4*
Nether-lands	32,334	35,876	40,829	40,630	48,155	48,765	48,424	47,019
	1.6%	1.8%	2%	2%	2.4%	2.5%	2.5%	2.5%
	28.6	*29.4*	*26.2*	*28.1*	*34.8*	*35.4*	*35.5*	*32.1*
Sweden	171,245	193,055	225,693	226,059	222,016	222,727	225,043	308,273
	5.8%	6.3%	7.2%	7.2%	7%	7%	7%	9.9%
	51.4	*57.8*	*63.7*	*67.1*	*70.7*	*75.5*	*79.8*	*108.2**
UK	578,803	631,223	732,932	688,330	664,495	609,483	605,311	682,196
	3.6%	3.9%	4.5%	4.1%	4%	3.6%	3.6%	4.8%
	165.7	*157.7*	*178.6*	*169*	*153.8*	*142.2*	*130.5*	*123.9*
Denmark	155,588	165,767	171,084	162,987	154,453	144,959	138,262	142,857
	5.9%	6.3%	6.5%	6.1%	5.8%	5.5%	5.1%	5.4%
	44.9	*47*	*46.1*	*46.4*	*50.9*	*50.1*	*50.8*	*50.3*
France	370,799	419,750	517,965	550,990	534,037	560,838	552,826	557,133
	1.2%	1.4%	1.7%	1.9%	1.8%	1.9%	1.9%	2%
	41.3	*40.5*	*45.9*	*48.5*	*48.3*	*49.2*	*47.5*	*46.5*
Poland	25,000	38,732	43,828	49,928	82,730	159,709	228,009	285,878
	0.14%	0.22%	0.26%	0.31%	No data	1.2%	No data	2.1%
	18	22	22	22	22	*22.2*	*24.8*	*24.1*

Source: Lampkin et al (2007) for 2000-2006. Poland from Habralova et al (2005) and 2007 data from Organic-Europe.net (FiBL, 2011c), and national UAAs from Eurostat (2010).

*There is an apparent increase in the average size of an organic holding in Sweden between 2006 and 2007 however this may be due to the fact that the data have been obtained from two different sources. Lampkin *et al.* (2007) note that their data for Sweden is sourced from KRAV only and so does not include “a small number of biodynamic farms” and also does not include policy-supported but un-certified organic holdings.

Table 2-2: Area used to produce specific products (ha) in 2006 (and the percentage of total organic production) in each country.

	Area organic arable (2006)		**Area organic vegetables, potatoes & herbs (2006)**		**No of organic dairy and beef cows (2006)**
Germany	253,689	30.7%	18,100	2.2%	500,000
Italy	349,308	30.4%	42,013	3.7%	222,725
Netherlands	12,404	25.6%	3,380	7.0%	50,000
Sweden	83,259	37.0%	1,740	0.8%	95,736
UK	76,302	12.6%	8,206	1.4%	244,752
Denmark	49,636	35.9%	2,138	1.5%	132,428
France	124,925	22.6%	11,205	2.0%	121,871

Source: (Lampkin *et al.*, 2007). D 5 –CEE- OFP

Table 2-3: Main uses of organic area in 2006

Country	**Arable crops (% of organic area)**	**Permanent grassland (% of organic area)**	**Green fodder (% of organic area)**	**Horticulture (% of organic area)**	**Other (% of organic area)**
Germany	29.7	49.7	14.8	2.2	3.8
Italy	24.6	22.8	25.9	21.8	5
Netherlands	21	62	0	8.4	8.6
Sweden	30.3	20.2	40.8	0.4	8.3
UK	11.8	70	16.9	1.2	0.1
Denmark	35.6	13.9	45.9	1	3.5
France	21	39.8	22.2	6.6	10.4
Poland	25.8	37.6	22.6	11.7	2.3

Source: European Commission DG Agriculture and Rural Development (2010)

Table 2-4: Structure of the total dairy industry in the countries in 2007

Country	Dairy cows (number) per specialised dairy farm	Milk yield (litres per cow) for specialised dairy farms	Dairy cows (number) per non-specialised farm	Milk yield (litres per cow) for non-specialised dairy farms
Germany	50	7190	41	6883
Italy	48	6993	16	4132
Netherlands	72	7787	62	7963
Sweden	53	8364	32	7374
UK	118	7171	81	6426
Denmark	119	8268	68	7721
France	46	6513	41	6490
Poland	16	5303	5	3925

Source: European Commission DG Agriculture and Rural Development (2010b)

Note that this is for the whole dairy industry as specific organic figures are available for all countries.

Table 2-5: Share of sales of organic production sold as organic in 2001 (%)

Country	Cereals	Potatoes	Milk
Germany	97	97	82
Italy	90	94	100
Netherlands	100	100	100
Sweden	100	100	75
UK	100	85	65
Denmark	100	100	31
France	100	100	87

Source: Hamm and Gronefeld (2004)

Table 2-6: Farmer prices for organic produce in 2001 (Euros per 100kg, Euros per 100 litres milk)

Country	Cereals	Potatoes	Milk
Germany	29	25	40
Italy	23	55	45
Netherlands	30	21	37
Sweden	19	32	37
UK	28	32	39
Denmark	23	24	40
France	26	No data	40

Source: Hamm and Gronefeld (2004)

Table 2-7: Overview of the organic certification and key standard differences in each country

	Type of certification system	**No of control bodies**	**No of private/public standards in 2007**	**No of standard differences per body recorded**	**Subsidy for certification costs (in 2007)**
	I)	II)	II)	III)	IV)
	A = Private CB B = Public CB/CAs, C = Combination	CA = Control authorities CB = control bodies			
Denmark	B	2 Public CA 1 private CB	2 public 1 private	11 differences	No charge for public control and certification
France	A	5 Private CBs;	1 public 1 private	21 22	Yes,As part of organic support scheme
Germany	A	22 Private CB	0 public 9 private	70/60	(Yes, part of organic support scheme > €35/ha)
Italy	A	18 Private CB	0 public 4 private	9	(Yes, Measure 132 RDP) Actual costs, max € 3000/year
Nether-lands	A	1 private CB	0 public 1 private	26	Yes, part of organic support scheme
Poland	C	1 public CA 6 private CB	1 public 1 private	8 private	Yes, Measure 132 RDP
Sweden	A	5 private CB	0 public 2 private	n/a 63 private	Yes, certification free of charge
UK	A	9 Private CB	0 public 1 private	17 public 16 private	(No)

Source: List of Bodies or Public Authorities in Charge of Inspection Provided for in Article 15 of Regulation (EEC) No 2092/91 *Official Journal of the EU* (2009/C 72/04).

www.organicRules.org – based on results of the Certcost project

www.organicRules.org – based on results of the EEC/2092/91 (organic) Revision project.

Schwarz et al (2010\) Organic Farming Support Payments in the EU. Landbauforschung Sonderheft 339. von Thünen Institut, Braunschweig.

Notes: Standard differences give an indication of likely differences during the period for which the data were collected. The survey was done in relation to the EU regulation 2092/91 now replaced by 834/2007, but not all private standards in Europe were surveyed. Private standards with high differences are likely to have been considered.

DK: Private body carries out additional controls. All operators have to undergo public control

DE &UK: Certification subsidies are only available in some regions

UK: The public standard (UKROFS) is no longer in operation
Certification subsidies have only recently been introduced, are only available in some regions and not all farms will qualify

Table 2-8: Government support for organic arable, grassland and vegetable area in 2001

Country	Arable – support for conversion to organic farming (Euro per ha)	Arable – support for maintenance of organic farming (Euro per ha)	Grassland – support for conversion to organic farming (Euro per ha)	Grassland – support for maintenance of organic farming (Euro per ha)	Vegetable area – support for conversion to organic farming (Euro per ha)	Vegetable area – support for maintenance of organic farming (Euro per ha)
Germany	185	160	177	153	414	331
Italy	170	150	170	150	600	540
Nether-lands	147	136	136	136	737	136
Sweden	140	140	54 (additional payments for animals per ha)	54	540	540
UK	143	-	117	-	-	-
Denmark	60	81	81	81	-	-
France	244 (average over 1st 5 years of conversion)	-	107 (average over 1st 5 years of conversion)	-	305 (average over 1st 5 years of conversion)	-

Source: Hamm and Gronefeld (2004)

2.2 Germany

Structure

The number of certified registered operators in Germany in 2006 was 23,978 compared with 15,468 in 2000 (Eurostat, 2011). In 2006 Germany was one of the most important cereal producers in Europe with 179,000 ha of cereal (soft wheat: 45,000 ha; rye:49,000 ha; barley 20,500 ha; oats 18,800 ha) (Willer *et al.*, 2008). Germany is also a major forage producer (122,000 ha) (Willer *et al.*, 2008). Germany had 430,000 ha of organic grassland in 2006 (Willer *et al.*, 2008).

In 2007 organic farms were 4.4% of all holdings and were distributed across the sizes of farms as follows: 3.7% of holdings <20ha, 4.3% of holdings between 20 ha and 50 ha, 3.6% of holdings between 50ha and 100ha and 4.8% of holdings > 100ha (Eurostat, 2011b). In 2007 the average utilisable agricultural area (UAA) of organic holdings (including organic and non-organic area) in Germany was 59 ha compared with 45 ha for non-organic holdings (European Commission DG Agriculture and Rural Development, 2010). The average size of holdings in Germany varies considerably across regions. In 2006 the smallest average holding size was found in the city state of Berlin at 8.8 ha UAA, several regions had between 17 ha and 68 ha UAA (Baden Wurttemburg, Bayern, Bremen, Hamburg, Hessen, Niedersachsen, Nordrhein-Westfalen, Rheinland-Pfalz, Schleswig-Holstein) and others had much higher areas of between 73.7 ha and 207.1 ha (Brandenburg, Mecklenburg-Vorpommern, Saarland, Sachsen, Sachsen-Anhalt, Thuringen (Lampkin *et al.*, 2007).

Germany has many small organic farms in the South which converted a long time ago and have strong ties to customers (thus they may lack the economies of scale available to larger farms and may have higher costs due to on-farm processing and direct marketing) and some very large farms to the North and East (which may benefit from economies of scale and so have lower costs). With regards to dairy production, this tends to be extensive in marginal areas and more very intensive in areas such as Northrhine-Westfalia (possibly leading to higher concentrate costs). This regional nature of production suggests that average figures for Germany may not give an overall picture and that figures broken down by region may give a more accurate impression of the cost structures for organic farming in Germany.

Market

Germany is the largest market for organic food in Europe and in 2006 sales totalled 4.6 billion Euros. Organic food accounted for 2.7% of total food sales in 2006 (Willer *et al*., 2008). The market for organic food grew at a rate of 18% in Germany between 2005 and 2006 (Willer *et al*., 2008). Multiple retailers (traditionally less important in the German organic food market) had above average growth rates as did specialist organic supermarkets whereas traditional organic shops suffered a reduction in market share (Willer *et al*., 2008). The number of households buying organic food regularly in Germany increased to 22% in 2006 (based on a survey of 1000 participants) and 55% bought organic products occasionally (Willer *et al*., 2008). There has been increasing interaction between the German organic retail sector and the conventional marketing structures (Willer *et al*., 2008). In 2006 Demeter was selling 10% of its products via the conventional trade and both REWE (national retailer with 3,000 conventional outlets) and the conventional discount retailer Lidl and Schwartz showed an interest in moving into the organic market.

Policy

Germany was among the first countries to introduce public support. Responsibility for agricultural policy and support lies with the *Länder* following common federal guidelines but with variation in payment rates and conditions between regions. From 1989 until 1992 organic farming was supported in Germany by a variant of the EU extensification scheme, prohibiting the use of synthetically produced chemical fertilisers and plant protection products on the entire farm and ensuring that animal husbandry had to meet basic rules for organic farming (Tuson and Lampkin, 2007). From 1994 organic farming was supported within the framework of the *Laender* agri-environmental schemes based on EU Council Regulation 2078/92 and since 1 January 2001 under Articles 22 to 24 of EU Regulation 1257/1999. Since 2002, the *Länder* can choose between two options of conversion support: option A leaves the support at a constant level during the first five years from conversion whereas option B gives front-loaded payments to the farmers in the first two years and payments for continued organic farming from the third year on. (Tuson and Lampkin, 2007).

Certification

Germany has nine private standards, several of which are aiming to have standards higher than EU regulation and more than 50 differences in standards compared to the EU regulation were reported for Natural and Bioland (which may increase costs for their producers). There are twenty two private control bodies in Germany (Organic Rules, 2011). More than half of the organic farm operations are members of one of the nine private associations (each with its own standard) active in Germany. These farmers manage more than two thirds of organically farmed land (Organic Rules, 2011). Certification costs in Germany may be subsidized (Organic Rules, 2011). In 2001 the German government established a national logo which is now widely used (Tuson and Lampkin, 2007).

2.3 Italy

Structure

The certified organic crop area (as opposed to certified in-conversion and fully organic land area as shown in Table 1) in Italy in 2006 was 801,350 ha compared with 502,070 ha in 2000 (Eurostat, 2011). The number of certified registered operators was 51,065 (Eurostat, 2011) compared with 55,432 in 2000. Compared to 2005 the amount of land under organic production increased substantially in 2006 (increase of 81,060 ha) (Willer *et al.*,2008). More than 9% of Agricultural land was organic in 2006 (Willer *et al.*,2008).

In 2006 Italy was one of the most important cereal producers in Europe with 239,092 ha of which 117,686 hectares are durum wheat (Willer *et al.*, 2008). Italy was also a major forage producer (297,441 ha) and oilseed producer (18,703 ha) (Willer *et al.*, 2008). Italy was also a major producer of organic olives (107,233 ha) (Willer *et al.*, 2008). Italy had 261,252 ha of organic grassland in 2006 (Willer *et al*., 2008).

In 2007 the average UAA of organic holdings (including organic and non-organic area) in Italy was 25 ha, compared with 7ha for non-organic holdings (European Commission DG Agriculture and Rural Development, 2010).

In 2003 (there is no regional data for 2007) the average sizes of organic holdings in Italy varied across the regions between 9.6 ha UAA and 41.1 ha UAA (Lampkin *et al.*, 2007). The smaller holdings with UAA less than 20ha were found in the regions of Friuli Venezia Giulia, Veneto, Trentino Alto Adige, Liguria, Abruzzo, Molise, Calabria, Puglia, and Campania. The larger holdings with UAA greater than 20 ha (which are more likely to benefit from economies of scale) were found in the regions of Piemonte e Valle d'Aosta, Lombardia, Emilia Romagna, Toscana, Umbria, Marche, Lazio, Basilicata, Sardegna, and Sicilia. Milk production is also highly variable depending on the breed of cow with yields varying from 2656 litres per cow for Valdostana P. N. to 8524 litres per cow for Frisona Italiana (del Prato, 2007). Some milk production will be intended for cheese production and so may entail additional costs such as on-farm processing of the milk into cheese. Given this variation across regions and dairy cow breeds, as was the case with Germany, it is very difficult to obtain average figures for Italy that are representative of the country as a whole and a regional approach may give a greater level of accuracy.

Market

In 2006 the Italian domestic organic market was worth approximately 1,900 million Euros with a further 750 million Euros of exports. Exports of organic products increased from 2005 by 25.7% with the main recipient countries being UK, Germany, France and Switzerland.

Policy

Agricultural policy in Italy is the responsibility of the regions (Tuson and Lampkin, 2007). Most regional authorities encourage the uptake of organic support in "Preferential Areas".

These are usually specifically identified in accordance with regional development strategies. Uptake is encouraged through two main mechanisms (or a combination of both) (Tuson and Lampkin, 2007):

- by granting higher payment rates to applicants whose holding is located in preferential areas (Abruzzo, Molise, Piemonte, P.A. Trento)
- by giving priority, in the applications assessment process, to applicants whose holding is located in preferential areas (Campania, Lombardia, Puglia, Toscana, Sardegna, Umbria, Veneto)
- both (Calabria, Emilia Romagna, Lazio, Sicilia).

Certification

There are eighteen control bodies in Italy and four private standard owners (Organic Rules, 2011). The EU logo is widely used in Italy. Certification costs for organic farmers may be subsidised by the regional Departments of Agriculture (Organic Rules, 2011). There is an emphasis on social justice with regards to the labour force in the Italian Organic Standards 2005 (Organic Rules, 2011). It is possible that this may have an impact on labour costs for Italian organic production.

2.4 The Netherlands

Structure

The certified organic crop area (as opposed to certified in-conversion and fully organic land area as shown in Table 1) in Netherlands in 2006 was 47,045 ha compared with 26,870 in 2000 (Eurostat, 2011). The number of certified registered operators was 2,316 showing little movement on the number of 2,388 in 2002 (Eurostat, 2011). In 2007 organic farms made up 1.1% of farms under 20ha, 1.7% of farms between 20 ha and 50 ha, 2.1% of farms between 50 ha and 100 ha and 4% of farms over 100ha (58% of all Dutch farms were under 20ha) (Eurostat, 2011g).

In 2007 the average UAA of organic holdings (including organic and non-organic area) in the Netherlands was 42 ha compared with 25 ha for non-organic holdings (European Commission DG Agriculture and Rural Development, 2010).

The average organic holding size per region in 2004 (there is no data for more recent years) demonstrates a regional nature to organic farming in the Netherlands. The average holding sizes vary from 20.1 ha UAA to 68.8 ha UAA. The smaller holdings (at an average of less than 30 ha UAA) are found in the regions of Gelderland, Utrecht, Zuid-Holland, Zeeland and Limburg whereas the larger holdings are found in Groningen, Friesland, Drenthe, Overijssel, Flevoland, Noord-Holland, and Noord-Brabant (Lampkin *et al.*, 2007). This suggests that there are larger farms in the North and smaller farms in the South of the Netherlands. This may impact on costs as larger farms may be able to make use of economies of scale to reduce costs.

Market

The market for organic food grew at a rate of 9% in the Netherlands between 2005 and 2006 (Willer *et al.*, 2008). Organic retail sales accounted for 1.9% of the food and drink market. The main source of organic food sales were whole food shops (43% of organic turnover) but discount stores showed an increase in organic sales. Organic dairy products had the highest share of the food market at 3.8%, followed by fresh fruit and vegetables (2.8%) (Willer *et al*., 2008). Growth had been steady at 5-7% in the years to 2006. In 2005 EkoPlaza launched a large organic supermarket triggering others to consider rethinking current organic shops.

Policy

The government subsidised organic production from 1994 under the scheme ‘Regeling Stimulering Biologische Productiemethode’ (RSBP; Organic Production Financial Incentive Scheme) (Tuson and Lampkin, 2007). It was then found that the uptake of organic agriculture in the Netherlands had stagnated and it was concluded that subsidies should be increased for farmers in conversion starting from 1999. Farmers could only have a payment for one 5-year period, the payment could be for either conversion or for continuing to farm organically if they had been organic farmers for some time and had never before had a subsidy for growing organic produce (Tuson and Lampkin, 2007). Up to 29th March 1999, the RSBP was open continuously for new applications. From then until 2002 the RSBP scheme was opened each year one or more times for a limited application window. In 2003 the scheme was not open for applications and in 2004 the RSBP was opened for applications for the last time. From 2005, support payments for continuing with organic farming were opened to all organic farmers, including those who had previously had assistance to convert (Tuson and Lampkin, 2007).

Certification

Agricultural products certified in the Netherlands as “organic” can be identified by the “EKO” trademark. Organic products are inspected by Skal, an independent inspection body appointed by the Dutch government (Biologica, 2011). The Dutch label for biodynamic products is Demeter. Inspection of biodynamic products is undertaken by Skal and Stichting Demeter (Biologica, 2011).

The regulations from SKAL include a specified minimum amount of space for various livestock and specified minimum grazing time, define feeds that can be used and specify how many days animals have to be out for pasture (Organic Rules, 2011). These may increase housing costs for livestock.

2.5 Poland

Structure

The certified organic crop area in Poland in 2006 was 47,570 ha (Eurostat, 2011). Compared to 2005 the amount of land under organic production increased substantially in 2006 (increase of 68,300 ha) (Willer *et al.*,2008). Poland is a major producer of organic fruit including new walnut plantations (50,200ha) (Willer *et al*., 2008).

The number of organic producers increased in 2006 to 9,194. Due to the small size of organic farms (20 ha on average) and lack of producer groups many organic products are sold as non-organic or consumed by the producers but there is increasing consumer demand (Soil Association, 2007).

Most of the organic farms do not specialise in a specific type of production but are mixed farms. The average size of an organic farm in Poland is about 20 ha, whereas the average size of all farms is 7 ha (FiBL, 2011d).

Since Poland had a shortage of available organic seed in 2006 they had a derogation to use conventional seed (Zakowska-Biemans, personal communication, 2010). This reduced seed costs in Poland as farmers did not have to pay the organic premium.

Market

A greater numbers of supermarkets were entering the organic market in 2006 and consumer demand for organic products was creating a deficit of raw ingredients (Willer *et al*., 2008).

Policy

In Poland before it joined the EU the law on organic farming was a parliamentary act called *Act on Organic Farming* which came into force in 2001. The act defined organic farming and introduced general rules. It was based on EEC Regulation 2092/91 (Tyburski and Zakowska-Biemens, 2003) but allowed the tethering of livestock. There were also areas where Polish law required additional procedures compared with the EEC regulations: such as attaching a statement on the level of air and water contamination of a given area from the Inspectorate for Environment Protection and a written statement on the level of soil contamination with heavy metals (Tyburski and Zakowska-Biemens, 2003). Ekoland rules set a minimum area that a farm has to set aside for biodiversity and define certain aspects in more detail than the EU regulation which may increase the costs of production (Organic Rules, 2011).

Certification

Prior to Poland joining the EU six private inspection bodies operated: AgroBioTest Ltd, Bioekspert Ltd, PCBC – Polish Centre of Research and Certification, COBICO Ltd, PNG Ltd, Ekogwarancja PTRE Ltd (Tyburski and Zakowska-Biemens, 2003). All of them performed inspection and certification in accordance with the state standards. Two private logos were present on the Polish organic market. The oldest, and best reputed was EKOLAND (which has both its own production standards and a logo) and the other one was PTRE logo (Tyburski and Zakowska-Biemens, 2003). Six control bodies now operate that are recognized by the competent authority alongside one public control authority (Organic Rules, 2011). Certification costs for organic farmers may be subsidized by the Agency for Restructuring and Modernization of Agriculture (Organic Rules, 2011).

2.6 Sweden

Structure

The certified organic crop area (as opposed to certified in-conversion and fully organic land area as shown in Table 1) in Sweden in 2006 was 201,298 ha compared with 143,552 in 2000 (Eurostat, 2011). The number of certified registered operators was 6,230 compared with 4,278 (Eurostat, 2011). In 2007, the percentage of organic farms increased from 4% to 5%. Organic farms made 1.9% of farms less than 20 ha, 4.2% of farms between 20 ha and 50 ha, 7.1% of farms between 50 ha and 100 ha and 9.8% of farms >100 ha (Eurostat, 2011d)

In 2007 the average UAA of organic holdings (including organic and non-organic area) in Sweden was 92ha (this may include, not just certified organic farms but also farms which are managed organically but are not certified) compared with 40ha for non-organic holdings (European Commission DG Agriculture and Rural Development, 2010).

In 2006 the average holding size per region varied from 48.9ha UAA to 107.4ha UAA (Lampkin *et al.*, 2007). The smaller farms (at less than 80ha UAA) could be found in the regions of Blekinge, Dalarna, Gavleborg, Halland, Jamtland, Kronoberg, Norrbotten, Orebro, Skane, Vasterbotten, Vasternorrland, and Vastra Gotaland and the larger farms could be found in the regions of Gotland, Jonkoping, Kalmar, Ostergotland, Sodermanland, Stockholm, Uppsala, Varmland and Vastmanland (Lampkin *et al.*, 2007).

Market

The turnover from sales of organic products in Sweden was estimated to be equivalent to 379 million Euros in 2006 which represents between 2% and 3 % of total food sales (Willer *et al*., 2008).

Policy

There are a wide range of measures implemented to support organic farming in Sweden (Tuson and Lamkin, 2007). Support for organic production started in Sweden in 1989 with conversion payments under the national regulation 'Förordning om stöd till alternativodling', which was updated in 1994 to give increased subsidies. Under EU regulation (EC) 2078/92, a regional programme was introduced in 1995, and under the E&RDP for Sweden an updated organic farming scheme was released in 2000 which was then centralized (Tuson and Lampkin,2007).

Training and education has been a strong feature of policy support in Sweden, with regional and national programmes as well as specialist advice provided by agricultural societies and private organizations (Tuson and Lamkin, 2007).

Certification

Sweden has no national certification body or legislation defining organic farming. Prior to 2007 two private sector inspection and certification bodies were recognised (KRAV and Svenska Demeterförbundet) (Tuson and Lampkin, 2007). KRAV is a private certification body for organic production and its standards include those for crop and animal production, processing, textiles, retailing, catering and importing. They are equivalent to the IFOAM standards for organic production (Tuson and Lampkin, 2007). In 2007 five control bodies were recognized. Certification costs of organic farmers may be subsidized by the Ministry of Agriculture (Organic Rules, 2011). KRAV standards, especially with regard to livestock feed and housing, exceed the EU regulations and so may impose different costs on farmers (Organic Rules, 2011).

2.7 The UK

Structure

The certified organic crop area (as opposed to certified in-conversion and fully organic land area as shown in Table 1) in the UK in 2006 was 489,108 ha (Eurostat, 2011) (compared with 242,473 ha in 2000). The number of certified registered operators in 2006 was 6,889 (Eurostat, 2011) (compared with 5,508 in 2000) and the number of organic producers was 4,639 which represented an annual increase of 7% (Soil Association, 2007).

The average size of an organic farm in the UK, as calculated by the Soil Association (2007), was 143ha in January 2006 and dropped to 132ha in January 2007 mainly as a result of large Scottish hill farms withdrawing from organic production in that period (Soil Association, 2007). In 2006 the fully organic farmed area in the UK was mostly grassland with permanent pasture at 72.3% and temporary leys at 15.2%, arable consisted of 8.8, horticulture 1.7% and the remainder consisted of land for forage, silage and other crops, woodland and land whose purpose was unknown (Soil Association, 2007).

In the UK in 2006 the average holding size varied from 54 ha UAA to 343 ha UAA (Lampkin *et al.*, 2007). Within England the size varied from 54ha UAA in the Eastern region to 255 ha UAA in the North East. The smaller farms (less than 100ha UAA) could be found in Yorkshire and Humberside, East Midlands, West Midlands, Eastern, and South West. The larger English farms could be found in the North East, North West, and South East. The average size of an English holding was 99 ha UAA whereas the average size of a Northern Irish holding was much smaller at 38 ha, UAA, a Welsh holding was similar to an English holding at 111ha UAA, and a Scottish holding was much larger at an average of 343ha UAA (Lampkin *et al.*, 2007). This suggests that organic farms are larger in the north of the UK compared with the South and this may have an impact on costs. It should be noted that the costs quoted in Section 3 of the report are for England and Wales only and so do not include the impact of the larger Scottish farms.

In 2006 production of organic arable cereals showed no increase but demand for animal feed and milling remained high especially as in August 2005 the EU confirmed that the non-organic component of organic animal feeds would drop from 10% to 5% for ruminants and from 20 to 15% for monogastrics (Soil Association, 2007). The area of organic horticultural land increased by 10% in the year to January 2007. Blight incidence in potatoes was below average (Soil Association, 2007), suggesting that crop protection costs may have been lower that year for potato producers.

It was estimated that 31,000 organic beef cattle were slaughtered in 2006 representing an increase of 13% and 291,00 organic lambs were slaughtered representing an increase of 41% (Soil Association, 2007). The number of organic pigs slaughtered showed, in contrast, a decrease of 10% despite continued demand for organic pork in the UK. This was partly attributed to high production costs which were exacerbated by the reduction in the non-organic element of organic feed. The organic poultry market continued to increase with a rate of 39% since 2005 up until 2007/08.

One deterrent to farms entering organic milk production (where a possible deficit in supply was identified) was the high cost of organic feed which was estimated at £260/tonne having increased significantly in 2006 (Soil Association, 2007). In 2006 there was a period of drought with high temperatures and so reliance on bought-in feed was as high as during the winter due to poor-quality pasture (Soil Association, 2007) thus high feed costs would be expected in this period.

Market

Organic food accounted for 2.5% of total food sales in 2006. The market for organic food grew at a rate of 20% in the UK between 2005 and 2006 (Willer *et al*., 2008). The UK organic market (including non-food products) grew by 22% in 2006 (Soil Association, 2007) although conversion of farms to organic remained slow. The market has declined recently in response to the financial crisis. The majority of organic foods (75%) in the UK are sold through multiple retailers (Willer *et al*., 2008; Lampkin *et al*., 2006).

Policy

Policy support is the responsibility of the devolved administrations. The Organic Aid Scheme (OAS) was introduced in all four regions in 1994 following EC regulation 2078/92. In 1999 this was replaced by the Organic Farming Scheme which led to an increase in organic land of 150,000 ha in nine months. It closed due to having spent its entire budget and was reopened in 2001. In 2003 support for farms which had converted was introduced and in 2005 the OFS was closed. After that, in England financial support for conversion existed in the form of payments during conversion under the organic entry level stewardship (OELS) from March 2005 scheme, in Wales through the Organic Farming Scheme (OFS) from 2006, in Scotland through the Organic Aid Scheme (OAS) and in Northern Ireland through the Organic Farming Scheme (OFS) (Lampkin *et al.*, 2006). In England support for maintaining organic farming was available under the OELS scheme which is open to all farms with organic certification, who manage all or part of their land organically and who are not members of the previous schemes (which were closed to new members but still continuing for current members). The OELS replaced the previous scheme (Organic Farming Scheme). In Wales in 2006 support was available through the Organic Management Scheme (OMS) giving support for 5 years after conversion. This payment could then be combined with either of the Welsh agri-environment schemes existing at the time (the older Tir Gofal and the new Tir Cynnal). In Scotland organic farms could enter the OAS (as with their conversion support scheme, this scheme is selective and subject to an environmental audit and the farm's compliance with good agricultural practice and environmental conditions). There was no further support in Northern Ireland after conversion in 2006 (Lampkin *et al.,* 2006).

Daugbjerg *et al.* (2011) found that in England the significant policy measures with regards to impact on organic producer numbers and total land area under organic production were the introduction of the Organic Farming Scheme in April 1999, the EC regulation 2092/91 amendment to include organic livestock and the replacement of the Organic Farming Scheme with the Organic Entry Level Stewardship Scheme in April 2005.

Certification

In 2007 there were 5 nationally operating and 2 regional based private organic certification bodies in mainland UK and 2 bodies registered in Ireland were also recognised by the competent authority of the UK. (Lampkin *et al.,* 2006). Certification costs for (Scottish) farmers may be subsidised by the Scottish government but not all operators qualify (Organic Rules, 2011). The Soil Association private standards include stricter provisions on livestock feed, grazing and housing compared with EU regulations and also include further detail on allowed fertilisers which may lead to higher cost (Organic Rules, 2011), The standards of the other bodies are very similar or identical to the EU regulation. The national standard of UKROFS is no longer in operation.

2.8 Denmark

Structure

The certified organic crop area (as opposed to certified in-conversion and fully organic land area as shown in Table 1) in Denmark in 2006 was 133,048 ha compared with 93,371 ha in 2000 (Eurostat, 2011). The number of certified registered operators in 2006 was 3,584 compared with 4,274 in 2000 (Eurostat, 2011). In 2007 the average size of an organic holding (including organic and non-organic land) in Denmark was 69 ha compared with 59 ha for a non-organic holding.

In 2006 the average organic holding size was 61.8 ha UAA in Jylland, 31 ha UAA in Sjaelland and 18.2 ha UAA in Fyn (Lampkin *et al.*, 2007) showing a large degree of regional variation. In Denmark organic farms are not only specialised but crop and livestock production take place in different parts of the country. Most of the organic animal production is concentrated in Jylland on sandy soils, whereas the islands Fyn and Sjelland have mostly clay soils and therefore mainly crop production (Padel et al., 2007). In 2006, 86% of organic grassland and 94% of organic dairy cow production were concentrated on Jylland and 78% of arable production (based on Lampkin et al., 2007).

Market

Organic food accounted for 4.5% of total food sales in 2006 (Willer *et al*., 2008). In 2006, Denmark suffered from organic milk oversupply but subsequently was trying to source more organic milk suppliers (Willer *et al*., 2008). The value of the organic market grew by 18% in 2006. Danish consumers came third in terms of organic spend per head within Europe (behind Switzerland and Lichtenstein) (Willer *et al*., 2008). In 2001 supermarket sales accounted for 80% of total organic food sales in Denmark (Daugbjerg *et al.*, 2011).

Policy

Denmark was the first country in the EU to support organic production, It enacted a law on organic farming in 1987 which provided state certification and labelling for organic products and gave subsidies for the first three years of the conversion period (Daugbjerg *et al.*, 2011). Regular subsidies for organic farming were introduced in 1994 as a consequence of EC regulation 2078/92 providing conversion subsidies for the first 2 years and permanent organic subsidies. These were altered in 1996 to increase the supply of arable and pig products (Daugbjerg *et al.*, 2011). In early 2000s these subsidies were altered to reward the provision of environmental benefits rather than specific commodities and an additional 2 year conversion period subsidy was made available to non-dairy farmers. In June 2007 this was extended to dairy farmers as predictions made in 2006 suggested that there would be an undersupply of organic milk in Denmark due to export to Germany (Daugbjerg *et al*., 2011).

In 1997 the state provided 90% of the cost of conversion advice for the 12 months before and after conversion (Daugbjerg *et al.*, 2011). Also, the state funded research into organic farming with the most recent programme providing funding of 27 million Euros for the period from 2005 to 2011.

In general, Denmark introduced measures 7 years earlier than the UK and used a greater range of policies (Daugbjerg *et al.*, 2011). This suggests that the Danish market may be more mature than the UK market and may have an impact on the costs. Daugbjerg *et al.* (2011) assessed which policy measures had the greatest effect on organic farming with respect to numbers of organic producers and the total land area in organic production. They found that the three policies which had the greatest impact on these indicators in Denmark were: the introduction of organic subsidies for non-dairy farms, the extension of permanent and conversion subsidies for a further period in 1997 and support towards marketing costs and expenditures .

Certification

Denmark has an official set of regulations and a single unique symbol for organic products - The regulations associated with the Ø label are based on EU legislation, although Danish rules still apply in a few areas where EU legislation does not cover all aspects of organic activities (FiBL, 2011b). The State carries out the inspections for this certification and also covers the costs, so that farmers don't have to pay for this. The Danish regulations from 2006 include the use of 100% organic feed for ruminants of which only 30% can be from in-conversion land (or 60% if grown on the farm) (Organic Rules, 2011). This is likely to increase feed costs. There are also several additional limitations with regards to substances used for crop protection and with regards to conversion (Organic Rules, 2011).

2.9 France

Structure

The certified organic crop area (as opposed to certified in-conversion and fully organic land area as shown in Table 1) in France in 2006 was 499,589 ha compared with 230,739 in 2000 (Eurostat, 2011). France was one of the most important cereal producers in Europe in 2006 with 83,861 ha of cereal (soft wheat: 30,146 ha) (Willer *et al*., 2008). France was a major forage producer (122,513 ha) and a major producer of oilseeds (18,708ha) (Willer *et al*., 2008). France had 219,763 ha of organic grassland in 2006 (Willer *et al*., 2008). In 2000 France had 14,485 certified registered organic operators and by 2005 this had increased to 16,566 (Eurostat, 2011).

Organic farms were 1.6% of holdings under 20 ha, 1.9% of holdings between 20 ha and 50 ha, 2.1% of holdings between 50 ha and 100 ha and 1.3% of holdings over 100 ha (Eurostat, 2011f). The average UAA of an organic holding (including the organic and non-organic land) in France in 2007 was 58 ha compared with 52 ha for a non-organic holding (European Commission DG Agriculture and Rural Development, 2010).

Market

Organic retail sales in 2006 were 1,700 million Euros and showed signs of continued growth. 75% of consumers regularly shopped for organic produce in multiple retailers, 37% at weekly markets, 30% at specialist shops, 22% in delicatessens and 23% on farms (Willer *et al*., 2008).

Policy

Producer support payments in France were controlled centrally but had regional elements in terms of support levels, types of agriculture supported and budgets available in each region (Tuson and Lampkin, 2007). Producer support payments in France were mainly for the conversion period (two to five years) with no ongoing payments to support organic farming after conversion. There were a number of revisions to the scheme, including a year-long break in 2003 due to governmental review. Other support measures in France included compulsory training schemes and support for marketing and processing (Tuson and Lampkin, 2007).

Certification

There are 5 private control bodies in France (Organic Rules, 2011). Certification costs for farmers may be subsidised by the regional directorates for Food, Agriculture and Forestry) (Organic Rules, 2011). There is a national logo for organic food (Agriculture Biologic). The French governmental regulations allow only 10% of the feed to be non-organic for both ruminants and non-ruminants and the Nature et Progres private regulation is even stricter as it requires 100% organic feed for all species except under exceptional climatic conditions (Organic Rules, 2011). This is stricter than the EU regulation and so may increase livestock feed costs for French organic farmers.

3 Production costs in organic farming based on national sources other than FADN

The FACEPA validation process of the GECOM showed that to ensure a correct interpretation of results from other sources in relation to GECOM cost estimations, a very careful examination of these sources is needed with respect to the approach used, the definitions of costs and cost categories, the definition and calculation of imputed costs and the scope of the costs allocated (Offermann and Kleinhanss, 2011). The challenges experienced during the collection and processing of cost data from other sources for conventional farming are amplified for organic farming not only due to even fewer sources being available, but also due to the greater importance of methodological issues concerning the treatment of farm-produced production factors and stronger interlinkages between all farm processes.

Against this background, this chapter starts with a discussion of the costs calculations from national sources which were available for this study, discussing the respective methodological approaches as well as details of each country's data. Production cost figures are then illustrated and compared between countries for milk, wheat and potatoes.

3.1 Data

Additional production costs data for validation purposes is often limitedly available. As described by Offermann and Kleinhanss (2011) production costs are rather given as specific cost items than activity or product specific figures. Even more limited than data for \`ordinary´ agricultural commodities is the availability of organic production cost data. However, organic data validation is of great importance due to small FADN sample sizes for many years and countries of production. The validation of organic GECOM estimations in this context is therefore done by means of EXCEL templates that were distributed, collected and analysed by the Organic Research Centre (ORC) in Newbury, UK. Experts from Denmark, France, Germany, Italy, the Netherlands, UK and Sweden provided product specific direct and imputed costs which was used to fill in these templates.

Table 3-1 gives an overview of the methodological approaches of these data. For each of the seven countries and three products the region, time period, source and methods are listed. The majority of the studies consist of data from the time period 2005-2006. In the case of France wheat and potatoes data from 2009 and for milk from 2000 to 2006 are used. For Germany, data from two different time periods (2004 and 2009 for milk, 1999-2002 and 2009 for wheat and 2009 for potatoes) are viewed. Where one single data set was not comprehensive, figures from other sources were used complementary.

Table 3-1: Methodological Approaches of National Studies other than FADN

	Denmark	France	Germany	Germany	Italy	Netherlands	Poland	Sweden	UK
Milk									
Region	No specific region	Basse Normandie	No specific region	No specific region	Firenze	No specific region	No specific region	No specific region	England and Wales
Time Period	2005	2000-2006	2004	2009	2005-2006	2006	2006	2006	2005/2006
Source	Statbank	Institut de l'elevage	KTBL	KTBL	Equizoobio	LEI	FADN	Swedish Board of Agriculture	Farm Business Survey
Method	Country Statistics	Farm Survey	Planning Data	Planning Data	Farm Survey	Farm Accountancy Data	Farm Survey	No information	Farm Survey
Potatoes									
Region		Brittany		No specific region		No specific region	No specific region	No specific region	England and Wales
Time Period		2009		2009		2005	2006	2006	2005/2006
Source		Arvalis - Institut du Vegetal		KTBL		KWIN data by WUR	FADN	Swedish Board of Agriculture	Simon Moakes (Farm Business Survey)/ Organic Farm
Method		Farm Survey		Planning Data		Expert Judgement	Farm Survey	No information	Farm Survey/ Planning Data
Wheat									
Region	No specific region	Pays de Loire	Schleswig-Holstein	No specific region		No specific region	No specific region	No specific region	England and Wales
Time Period	2005	2009	1999-2002	2009		2005/2006	2006	2006	2005/2006
Source	Statbank	Arvalis - Institut du Vegetal	KTBL	KTBL		KWIN data by WUR/LEI	FADN	Swedish Board of Agriculture	Simon Moakes (Farm Business Survey)/ Organic Farm
Method	Country Statistics	Farm Survey	Planning Data	Planning Data		Expert Judgement/ Farm Accountancy Data	Farm Survey	No information	Farm Survey

Source: Own composition based on national sources

With regard to data generation there are three different groups the countries´ data can be assigned to:

- FADN (partly Denmark, Netherlands and UK),
- farm survey (France, Italy),
- planning data (partly Denmark and UK, Germany).

FADN data are based on annual accounts of representative test farms within this network. Farm surveys are smaller in terms of sample size and spatial dimension than FADN data. The farm surveys used in this study are based on samples between 10 and 30 farms and often have a local focus (particularly in Italy). Planning data make use of expert estimated figures. Since for instance a machine’s useful estimated life may deviate from its actual life, estimated cost data might be higher than empirical data and as a consequence cause an overestimation of production costs.

Allocating costs to specific products in organic farming poses many challenges (e.g DLG 2007) and the data sources available for this study have often chosen different methodological approaches to deal with these, which need to be considered when interpreting the results. Important differences relate to the following aspects:

1. Cost allocation of fertilizers in crop production systems

As organic cash crops such as potatoes or wheat usually represent one segment within a long-term crop rotation, the question arises how to account for the value of internal transfers of nutrients in such systems. With regard to fertilizer costs the data sets used show methodological differences across countries. Nutrient costs can either be considered as directly by accounting for the market value of manure, spreading costs of livestock manure and incurred costs like phosphorus or lime costs or indirectly by accounting for crop rotational transfers like clover/gras pasture. In the studies considered nutrient costs are treated as follows:

- In the case of the Danish, the Dutch and the Swedish data only organic fertilizer costs (market prices) are taken.
- For Germany 2002 (only applicable for wheat) the crop’s nutrient demand is accounted for within the crop rotation. That means an estimated farm internal monetary value is used which considers full costs of nutrient accumulation measures (e.g. legumes or intercrops).
- For Germany 2009 and UK only the variable costs of muck spreading are considered. This approach implies that muck is treated as waste and does not have any market value.
- The French and the Italian data sets lack information about data generation about fertilizer costs.

2. Possible variations in organic standards:

Since in most cases the countries´ data sets do not provide any information about production standards, cost effects of higher production standards such as private standards are not considered.

3. Climatic vulnerability and potential inter-annual cost variations:

Environmental conditions have an impact on yields and costs in OF. Using data from one single year of production makes comparisons difficult since costs in this single year might not represent the costs generally prevailing (for instance due to certain diseases in this year). Euvrard (2010) points out that in 2007 French potato crops were badly affected by blight resulting in low yields and high costs of crop protection. This issue can be tackled by taking data from a time series of more than one year. Stanhill (1990) recommends using data from a full crop rotation (minimum 3-5 years).

Regarding the data on hand for this study: In all cases where data from a time series of several years are available such data are used. This is the case for milk data from France (2000-2006) and for wheat data from Germany (generated 1999-2002). For the remaining countries and products data from one single production period are taken.

4. Farm heterogeneity in organic agriculture:

Wherever available, data that ensure good comparability due to similar farm structures (UAA, herd size, feeding intensity, etc.) are taken. There are basically three `intensity groups´ for each product, the countries´ data can be assigned to. Milk: (1) High intensity: Denmark, Italy (although big interregional differences can be observed in here) and Sweden, (2) medium intensity: Germany 2009 and the Netherlands and (3) low intensity: France, Germany 2004 and UK.

Potatoes data show the following picture: (1) High yields: Netherlands, (2) medium yields: France, Germany and UK and (3) low yields: Sweden.

Wheat data are less variant. More or less equal yields are shown by Denmark, France, Germany 2002, Germany 2009 and Sweden. A slightly higher yield is shown by UK and the highest yield is shown by the Netherlands.

5. Replacement costs in dairy production systems:

In the case of the British and the German (2004 and 2009) case studies, livestock is accounted for as being imported to the farm to replace culled cows. Therefore, livestock purchase costs are calculated by multiplying the mortality rate with auction-based prices for heifers.

Where stock replacement cows are not market purchased (as for the remaining countries) breeding is carried out farm-internally. These breeding costs are included in the respective cost categories of the case studies[1].

6. Roughage fodder and litter costs in dairy production systems:

- Roughage fodder in dairy systems is assumed to be market purchased in the studies from Denmark, Germany 2009, Italy and Sweden. Therefore, forage market prices are used to assess roughage fodder costs.
- In the studies that consider roughage fodder as cultivated farm-internally (France, Netherlands and UK) farm-internal production costs are accounted for. Land costs of the area used for fodder production are added in production costs II.
- Roughage costs for Germany 2004 are based on full cost calculations. Consequently, roughage land and labour costs are included in production costs I and therefore not listed in production costs II.

Roughage fodder costs and litter (straw) costs are given as a sum.

7. Assignment of various costs to overhead costs:

General farm costs that accrue independent of the extent of production are categorised as overhead costs. These are insurances, organic certification costs or certain taxes. In the UK and Sweden potatoes and wheat data irrigation costs are included besides the overhead costs named above.

8. Labour, land and capital costs:

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[1] Detailed information about farm-internal breeding costs and the assignment of costs to the respective cost categories are not available.

- Labour costs are given as the sum of family and imputed labour costs. In the case of farm surveys, wages are calculated by taking empirical data. When costs are estimated on the basis of planning data, calculatory wages (e.g. from the agricultural wages board) are considered.
- Where data are provided, the country specific land costs are extracted from the respective data sets. Where data sets lack these figures, Eurostat land costs are used supplementary. All land costs are given as rental prices.
- Capital costs are calculated on the basis of the country specific interest rates. Fixed capital costs are provided for milk. Here, the sum of capital costs of buildings and machinery is given. For potatoes and wheat working capital costs are calculated for a time period of three months. Fixed capital costs for potatoes and wheat are not available.

In the following, the data basis used for cost estimations is described for each country in detail.

The **Danish** organic milk and wheat data are extracted from the national Danish statistical database. Dependent on farm type, representative agricultural enterprises are taken and the costs of the respective categories (seeds, fertilizer, energy) are divided by the mean area of farmed land in hectares. Imputed labour costs of milk and wheat are also extracted from the national Danish statistical database, whereas land costs are taken from Eurostat. The data set provides an average annual milk yield of 7582 kg per cow, a potatoes yield of 20 tonnes and a wheat yield of 4.1 tonnes per hectare.

For **France** three data sets which are all based on farm surveys are used. Milk data by the Institut de l´elevage are most representative because dairy farms are surveyed throughout the entire country over the time period 2000-2006. The sample size is 20 farms. Potato and wheat data originate from the Arvalis - Institut du Vegetal. For potatoes average figures of a group of 25 farms from various regions in France are taken. The period surveyed is 2008/2009. The average annual yields are 4762 kg milk per cow, 22.5 tonnes (a range of 15-30) of potatoes and 4.1 tonnes of wheat per hectare.

The **German** data sets are extracted from the literature and online data base by the Association for Technology and Structures in Agriculture (KTBL). To assess the influence of energy and fodder price fluctuations, different time periods are viewed. Data from 2004 and 2009 for milk as well as from 1999-2002 and 2009 for wheat are considered. Potatoes data from 2009 are used.

Milk and wheat figures for 1999-2002 and 2004 are both taken from the Management Handbook for Organic Farming by Redelberger (2004). Data originate from agricultural management reports by the chamber of agriculture and the organic advisory and experimental service in the federal state of Schleswig-Holstein. 2009 milk, potatoes and wheat data are downloaded from KTBL online data collection for organic enterprises. KTBL data are planning data and therefore based on an estimated approach.

To assure product costs comparability over time, holdings that show approximately the same structural conditions are chosen. Wheat calculations for both time periods are carried out under the assumption of a field size of 5 ha, a medium soil quality and a farm-field distance of 5 Km. Milk data are based on a herd size of 60 animals and an annual yield of

5500 kg per cow (2004) as well as a herd size of 58 animals and an annual yield of 6000 kg per cow (2009). Underlying dairy cow replacement rates are 25% (2004) and 24% (2009).

Italian milk data are extracted from Chiori et al. (2006), surveying a farmers´ cooperative in Firenze region. The utilisable agricultural area is 171 ha and there are 210 livestock units. The average milk yield is 7783[2] kg per cow and year.

Dutch data for milk are based on 2006 FADN data provided by the Landbouw Economisch Institut. Number of holdings sampled is 18. The UAA is 56 ha. The number of dairy cows is 70. Unlike milk, product-specific data for organic potatoes and wheat are not available. Instead, average farm-type specific (arable, field vegetable) data are used to provide some of the data (e.g depreciation, land costs, labour costs). Potatoes and wheat specific data are taken from Quantitative Information of Agricultural Businesses (KWIN) data set by the Wageningen University and Research Centre.

Swedish potatoes and wheat data originate from the Swedish Board of Agriculture. No specific region is surveyed. For potatoes and wheat a medium yield is assumed (18 tonnes of potatoes and 3.6 tonnes of wheat per hectare).

UK data are based on the Farm Business Survey (which feeds into the FADN) and planning data/expert judgements in England and Wales. It should be noted that the costs do not include the impact of the larger Scottish farms. Where necessary, data are added from agricultural Management Handbooks by Lampkin et al. (various years), John Nix (various years) and the Scottish Agricultural College (2008/2009).

Milk data 2005/2006 originate from the farm business survey as quoted by Simon Moakes in "Farm Incomes in England and Wales". A milk yield of 5283 kg per cow and year is given.

Potatoes and wheat data are extracted from the Organic Farm Management Handbook by Lampkin et al. and supplemented with data from the John Nix Farm Management Pocketbook. For potatoes a yield of 25 tonnes and for wheat of 5 tonnes per hectare is assumed.

3.2 Production costs of milk

Figure 3-1 provides an overview of production costs I per tonne milk. Production costs I are defined as all costs excluding labour, land and capital costs. The countries are categorised according to their methodological approach of roughage costs calculations. The first group is based on full cost or market price fodder calculations, and thus implicitly include costs for land and labour used for fodder production. The second group is based on farm-internal roughage fodder production.

In the first group Germany 2009 shows the highest costs, followed by Germany 2004, Denmark and Italy. In the second group the Netherlands show the highest costs ahead of France and the United Kingdom.

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[2] Due to non-availability of yield figures, this value was derived by dividing milk-based revenues by the milk price per litre.

As pointed out in the introduction, livestock replacement costs in the case of Germany (04 and 09) and UK are based on auction prices. They are about 50 Euro per tonne milk for Germany and about 40 Euro per tonne milk for UK.

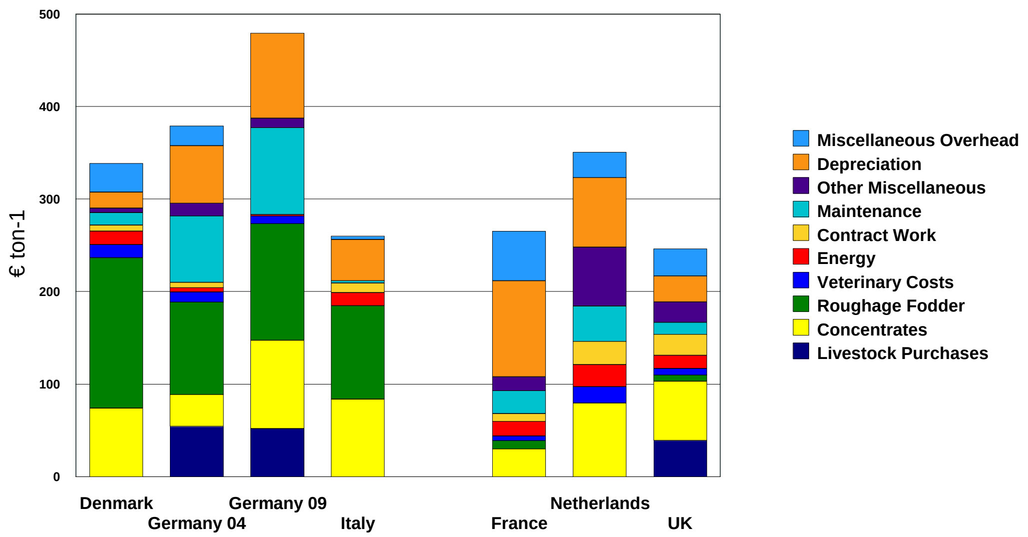
Looking at the figures of every single cost category it can be asserted that where it is market purchased, roughage fodder costs account for the highest costs of all cost categories (between 50 and 160 € per tonne). These figures cover total costs of fodder production (including land and labour). Concentrates account for 30 to 96 Euro per tonne milk.

Depreciation costs are shown as the sums of machinery and buildings depreciation and vary between 17 (Denmark) and 104 (France) Euro per tonne milk. Veterinary costs range from 5 (France) to 18 (Netherlands) Euro per tonne milk. Energy costs are comparable in amount to veterinary costs (1.4 to 24 € per tonne milk). They are given as the sum of electricity and fuel costs in all of the studies.

Maintenance is the machinery and buildings maintenance added together. Maintenance accounts for 2.6 (Italy) to 94 € (Germany 2009) per tonne milk.

Miscellaneous overhead costs vary from 3.9 (Italy) to 54 (France) € per tonne milk. For Germany 2009 no miscellaneous overhead costs are available.

Figure 3-1: Production costs I of organic milk



For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: Own illustration based on national cost calculations.

As illustrated in Figure 3-2, production costs II (which include labour and land costs) are highest for the Netherlands, followed by Germany 2009, Italy, Germany 2004, Denmark, France and United Kingdom.

In those cases where fodder is market purchased or fodder costs are estimated based on market prices, respective forage land and labour costs are already accounted for in production costs I (as shown in figure 3-1). Where roughage is grown farm-internally, land costs are accounted for in production costs II. This is the case in the studies from France and the Netherlands (see figure 3-2). In the case of Italy and the UK the fodder is partly grown farm-internally and partly imported from outside the farm. Consequently, land costs are comparatively low in these two countries (14 (Italy) and 25 (UK) vs. 55 (France) and 57 (the Netherlands).

Labour costs are given as the sum of family and imputed labour costs. They range from 23 (France) to 225 € (Italy) per tonne milk.

Capital costs are given as total fixed capital costs (machinery and buildings). With Denmark (44 € per ton) and the Netherlands (129 € per ton) capital costs are only available for two countries.

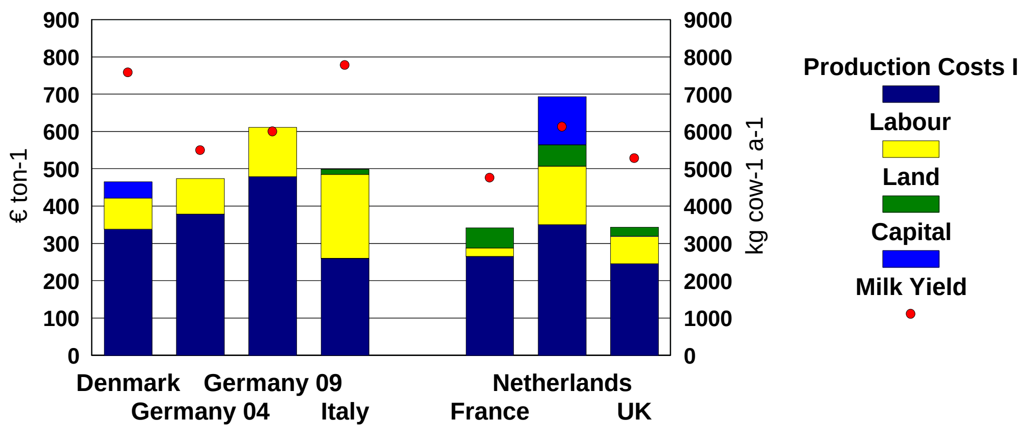
To get an impression about costs dependent of production intensity, the milk yield is given in kg per cow and year on the secondary Y-axes of Figure 3-2. Denmark and Italy show relatively high yields (appr. 8000 kg), Germany 09 and the Netherlands medium yields (appr. 6000 kg) and France as well as Germany 04 and UK lower yields (appr. 5000 kg).

The United Kingdom has the lowest production costs II, followed by France, Denmark, Germany 2004, Italy, Germany 2009 and the Netherlands. France and UK which show the lowest milk yields also show the lowest production costs II (349 and 345 € per tonne).

However, it must be noted that the data bases of the two countries lack fixed capital costs. On the basis of the other countries´ figures, imputing these figures would cause an increase of production costs II of 50 to 100 Euro per tonne milk[3]. As a result, France and UK would still show the lowest production costs II but almost in line with Denmark and Germany 2004.

Although Italy shows comparatively low production costs I, with 225 Euro per tonne milk it has the highest labour costs of all countries and consequently the third highest production costs II. Being compared to Denmark which displays approximately the same yield as Italy, labour costs are about three times as high.

Figure 3-2: Production costs II and annual yield of organic milk



For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: Own illustration based on national cost calculations.

[3] Fixed capital costs vary from 44 (Denmark) to 129 (Netherlands) Euro per ton milk.

3.3 Production costs of wheat

Figure 3-3 illustrates productions costs I of organic wheat. The Netherlands show the highest costs, followed by Denmark, Germany 2002, France, Germany 2009 as well as UK and Sweden. As it was the case for milk, not all cost categories are available for all countries.

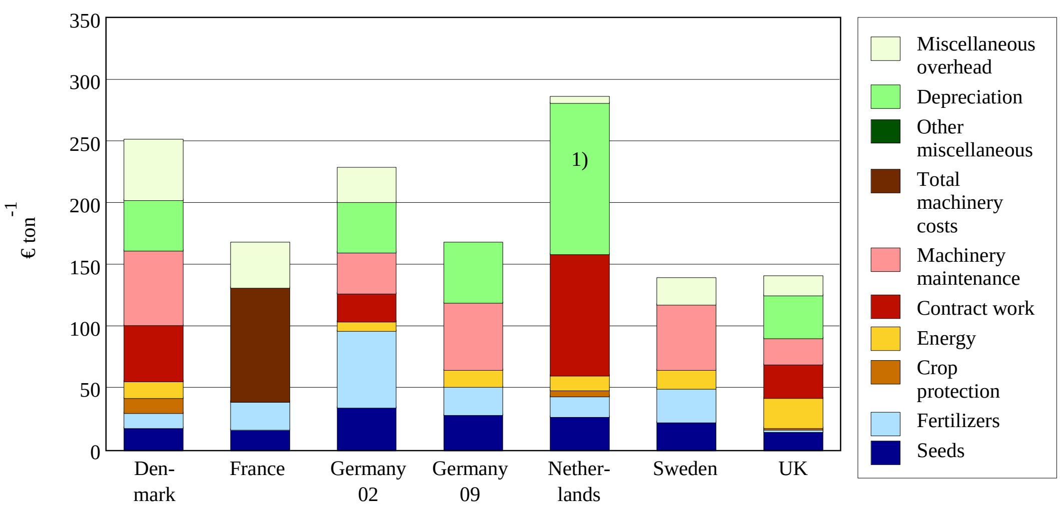
Seed costs are relatively even across countries. They range between 16 (UK) and 36 (Germany 02) Euros per tonne wheat. Fertilizer costs reflect differences in methodological proceedings of the studies. The UK, where fertilizer costs are only accounted for by considering variable costs of muck spreading, shows the lowest costs (2 € per tonne). Germany 2002, where total costs of nutrient accumulation measures are considered, shows the highest costs (61 € per tonne). The remaining countries show fertilizer costs of 13 to 25 Euros per tonne.

Energy costs (again given as the sum of all forms of energy) range between 9 (Germany 2002) and 25 (UK) Euro per tonne wheat.

Contract work is considered in the studies from the Netherlands (97 €), Denmark (46 €), UK (27 €), Germany 2002 (23 €). Machinery maintenance accounts for 61 (Denmark) to 11.6 (Italy) Euro per tonne wheat. French machinery costs are given as total costs (depreciation, energy and maintenance).

Depreciation costs per tonne wheat account for 123 € (Netherlands) to 29 € (Denmark). For the Netherlands average figures of mixed arable organic farms are used to get the per hectare values and these are divided by the wheat-specific yield figure from the KWIN data. Miscellaneous overhead costs are 4 (Netherlands) to 49 (Denmark) Euro per tonne wheat.

Figure 3-3: Production costs I of organic wheat



1) Mixed arable farm figure.

For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: Own illustration based on national cost calculations.

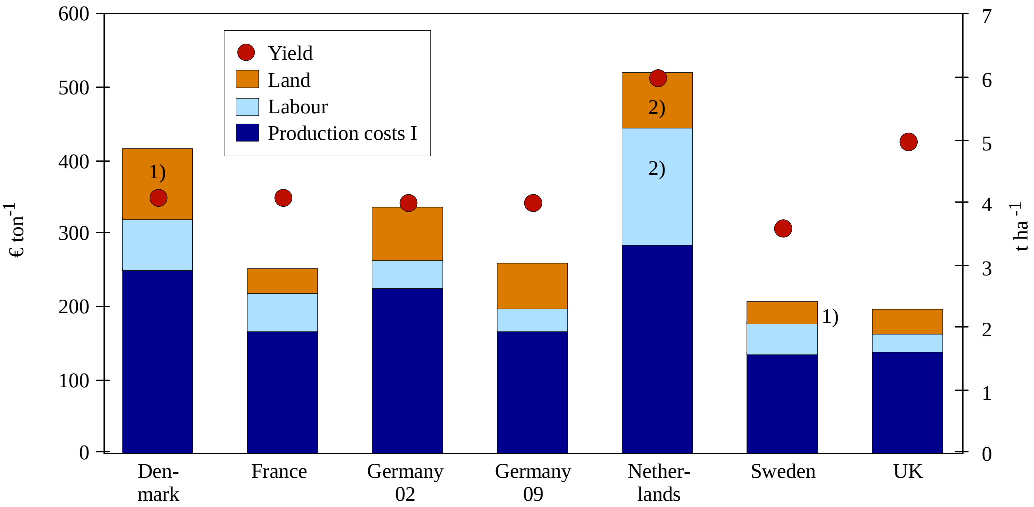
Production costs II of organic wheat are highest for the Netherlands, followed by Denmark, Germany 2002, Germany 2009, France, Sweden and UK (Figure 3-4).

Labour costs are given as the sum of wages and imputed labour costs. They range between 163 € (Netherlands) and 22 € (UK). Again the Dutch data are remarkably high compared to the other countries´ data. As was the case for depreciation, the use of mixed arable farm data divided by the potato yield might cause an overestimation of labour costs.

Land costs are 97 (Denmark), 71 (Germany 2002 and Netherlands), 60 (Germany 2009), 44 (Sweden), 32 (France) and 30 (UK) Euro per tonne wheat.

Working capital costs are again not illustrated here because they are too low to be visible in the diagram.

Figure 3-4: Production costs II and yield of organic wheat



1) Extracted from Eurostat.
2) Mixed arable farm figure.

For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: Own illustration based on national cost calculations.

3.4 Production costs of potatoes

Figure 3-5 shows the production costs I of potatoes in Euro per tonne. The costs decrease by the following order of countries: Sweden, France, UK, the Netherlands and Germany. However, it should be noted that not all cost data are available for all countries (e.g contract work figures were not collected for France, Germany and Sweden).

Seed costs account for the biggest amount of the total production costs I. They vary from 41 (Netherlands) to 96 (Sweden) Euro per tonne output.

Fertilizer costs range between 2.4 (Germany) and 13.6 (Netherlands) Euro per tonne. Here, the impact of the different methodological approaches to account for fertilizer costs (as described in chapter 3.1) can be observed. Germany and UK (only variable costs of muck spreading considered) show low fertilizer costs compared to France, Netherlands and Sweden (market prices for organic fertilizers taken).

Crop protection costs account for 3.9 (Netherlands) to 9.3 (Germany) Euro per tonne. The French and the German data consider pesticide costs. The Dutch and the Swedish values are calculated on the basis of thermal crop protective measures (gas burning).

Energy costs are given as the sum of fuel and electricity costs. Energy costs are comparable in amount to crop protection costs (2.5 for Sweden to 9.2 € per tonne for the Netherlands).

Contract work is accounted for in the studies from the Netherlands (7.7 €) and the UK (17.6 €).

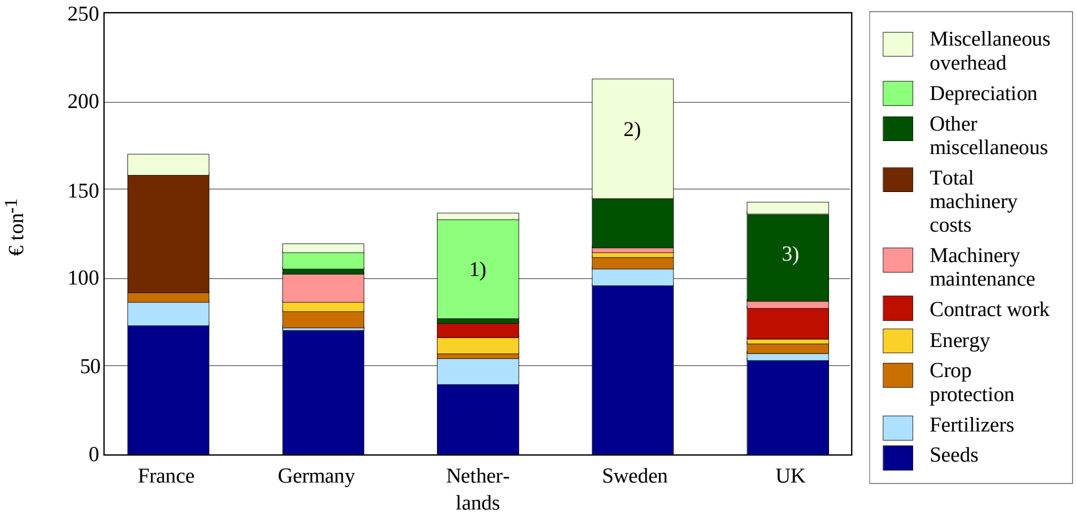
Machinery maintenance is highest for Germany (17 € per tonne), followed by Sweden (3.9 € per tonne) and UK (3.7 € per tonne). In the case of France mechanisation costs are given as the sum of depreciation, energy and all other variable machinery costs (total machinery costs; 67 € per tonne).

Other miscellaneous costs account for two (Netherlands) to 50 (UK) Euro per tonne. In the case study from the UK field-farm transportation costs of the potatoes are included.

Depreciation costs are 56 (Netherlands), 9 (Germany) and 5.6 (UK) Euro per tonne. The high value of depreciation in the case of the Netherlands is due to the fact that the figure was given by taking the average field vegetable depreciation figure from the data from LEI (on a per hectare basis) and dividing it by the potato yield per hectare as stated in the KWIN data instead of using an entirely potato-specific number (as these were not available).

Miscellaneous overhead costs vary from 2.9 (Netherlands) to 66 (Sweden) Euro per tonne potatoes. The comparatively high values for Sweden can be explained by the inclusion of irrigation costs (see footnotes in the graph).

Figure 3-5: Production costs I of organic potatoes



1) Field vegetable figure.
2) Including irrigation.
3) Including transportation.

For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

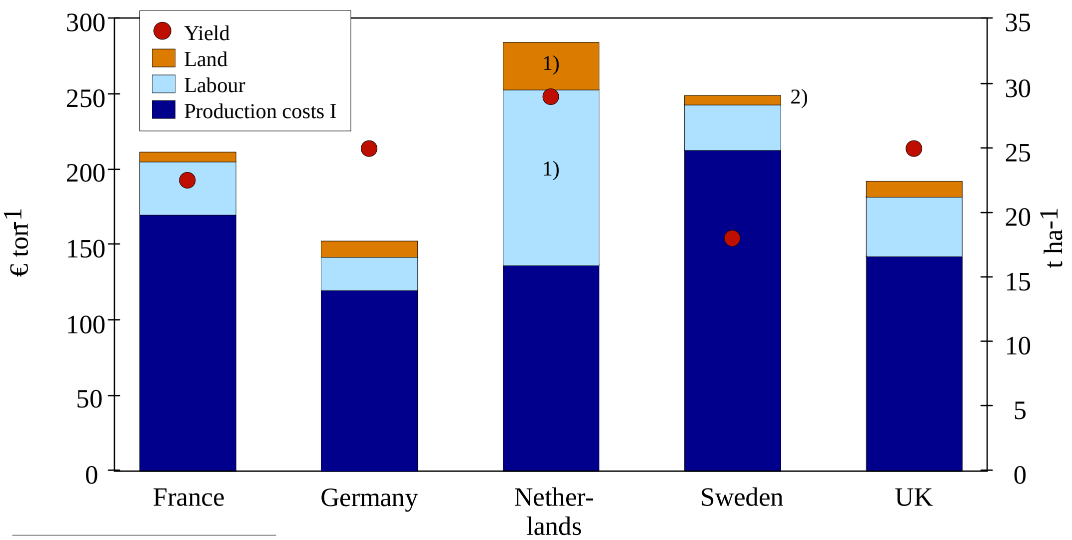
Source: Own illustration based on national cost calculations.

In the next step production costs II of organic potatoes are presented. Capital costs are not illustrated because figures are too low to be visible in the diagram.

As shown in figure 3-6, production costs II range between 153 and 285 Euro per tonne potatoes. They decrease by the following order of countries: Netherlands, Sweden, France, UK and Germany. On the secondary Y-axes the yield in tonne per hectare is given. The Dutch data set shows the highest yield with 29 tonne per hectare, followed by Germany and UK (both 25 t), France (22.5 t) and Sweden (18 t).

Labour costs are again given as the sum of family and imputed labour costs. They account for 23 (Germany) to 116 (Netherlands) Euro per tonne potatoes. Land costs range from 6 (France) 31 (Netherlands) per tonne potatoes. It should be noted again, however, that the Dutch data have been obtained by dividing figures for open field vegetables with a potato-specific yield figure and so may be higher than a fully potato-specifc figure would be, if it were possible to obtain it.

Figure 3-6: Production costs II and yield of organic potatoes



1) Field vegetable figure.
2) Extracted from Eurostat.

For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: Own illustration based on national cost calculations.

3.5 Synthesis

Viewing the data basis and the results of the national production cost analysis, it can be summarised that the biggest issues arise from limited data availability and different methodological approaches of data generation across countries. Due to a big variety in these cases, different approaches are of particular relevance for:

- fodder costs (milk),

- livestock replacement costs (milk) and
- estimated costs of nutrient transfers within crop rotations.

Albeit these differences a good comparability could be ensured for milk for the first group of countries (roughage fodder market purchased; see figure 3-2), for wheat with the exception of the Netherlands (overestimation due to field vegetable data) and for potatoes with the exception of the Netherlands as well as Sweden, where data have to be viewed with caution due to above-average overhead (caused by irrigation) as well as extraordinary high total costs.

Besides absolute values, the structure of the production costs (cost composition) looks similar in most cases. Exceptions are the Netherlands (for all of the three products) and France (for wheat and potatoes).

4 Estimation and validation of production costs in organic farming based on FADN data

This chapter describes the application of the GECOM model developed in the FACEPA project (references) to samples of organic farms, focussing on the comparison of the respective estimation results to the cost calculations from other national sources as described in Chapter 3. In view of the availability of comparative data, the analysis is restricted to milk, wheat and potatoes.

4.1 Data

In the EU-FADN the variable for organic farming (A32) is included since 2000, where A32 = 2 indicates that the farm applies only organic production methods. In Table 1 the number of organic farms for each country over the years 2000-2007 is presented (as well as the number of organic farms in the German national FADN). As a rule of thumb, for reliable GECOM estimates samples should include ≥ 100 observations. If the sample is smaller, many negative coefficients appear and thus, even if the mean over the entire sample period is taken, the results get implausible. As can be seen from Table 4-1 only a few countries have a data set for organic farms which is big enough for analysis. These countries are: Austria, Germany, Denmark, The United Kingdom, France, Italy, Poland, and Sweden, and accordingly the model is applied to these countries.

Only for Austria and Germany is the organic sample big enough for all of the years from 2000-2007, while in most other countries samples are often small in the period 2000-2003. However, the data availability for these countries increases from 2004 onwards. FADN data for the new member state Poland have been included since the country joined the EU in 2004.

To increase robustness of results and facilitate interpretation, GECOM estimates have been averaged over the time period where samples were big enough for econometric estimations (as shown in table 4-1), whereas the results from other national sources originate from the production year 2005/2006 in most of the cases (see Chapter 3.1) and 2004 and 2009 for Germany.

Table 4-1: Number of fully organic farms in the EU and German FADN

	2000	2001	2002	2003	2004	2005	2006	2007
EU-15								
AT	316	296	289	299	320	337	370	377
BE	.	17	22	26	40	34	39	31
DE	125	226	254	251	261	263	277	299
DK	75	79	75	73	288	94	295	290
ES	25	27	155	92	76	106	123	131
FI	58	55	64	70	71	83	85	91
FR			67	88	87	122	138	148
GR			.	26	17	26	62	88
IE					.	15	17	16
IT		544	658	348	496	581	693	700
LU	.	.	.	.	.	.	.	.
NL	.	40	49	41	41	51	54	55
PT	16	29	30	32	51	36	39	47
SE			53	156	147	193	220	209
UK	.	28	34	55	65	62	114	113
NMS								
CY					.	.	.	.
CZ					66	71	72	69
EE					.	.	35	48
HU					.	17	24	20
LT					18	32	66	79
LV					38	59	106	137
MT						.	.	.
PL					119	128	140	195
SI					53	71	82	95
SK					15	21	19	20
EU-25	1,327	1,327	1,768	1,566	2,311	2,423	3,071	3,258
DE-FADN	279	334	355	412	446	461	475	515

. = less than 15 sample farms.

Source: EU-FADN DG-Agri L-3 and German national FADN.

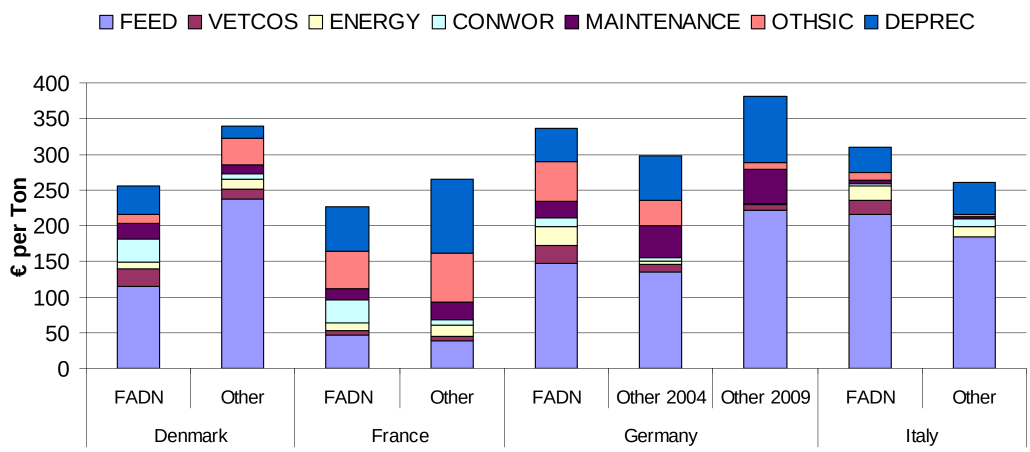
4.2 Results for milk

Figure 4-1 shows production costs I of 230 to 370 Euros per tonne organic milk for Denmark, France, Germany and Italy. In all countries except for France, feed costs account for the highest amount of all cost categories. The evidently high difference in feed costs in the case of Denmark can be explained by the fact that for other data market prices are taken to calculate fodder costs (see chapter 3 for further illustration) which is a different approach to the way it is done by means of the GECOM.

Except for the cost category “depreciation” the French cost data show a good match. The total difference in production costs I is less than 40 Euros per ton.

Comparing the German FADN (mean ´00-´07) and German other data from 2004, a good degree of match can be observed. German “other 2004” and “other 2009” maintenance include fuel costs, so that also for this cost category the FADN estimates (sum of maintenance and energy costs) match the reference data well. Watching the German “time series”, an increase of fodder costs can be seen which is due to higher world market prices comparing 2004 and 2009 data.

Figure 4-1: Production costs I of organic milk



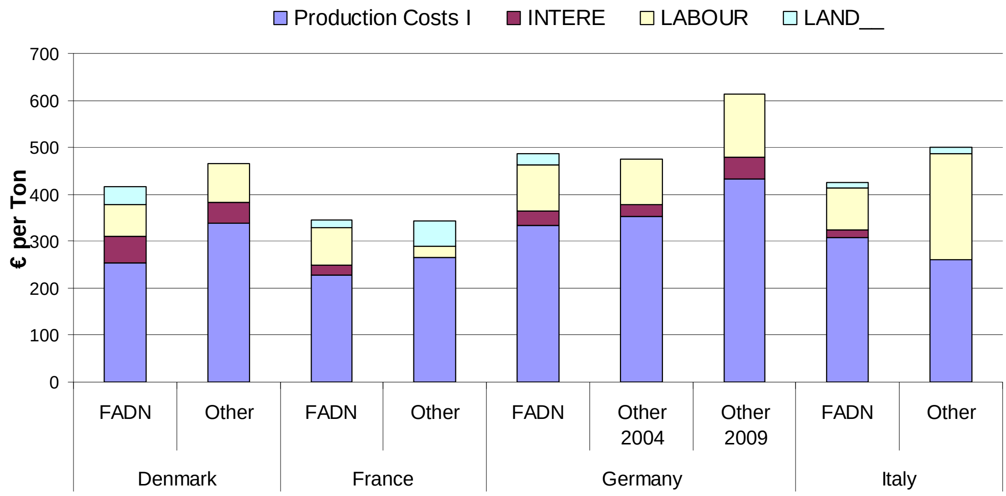
For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in Chapter 3.1.

Source: EU-FADN DG-Agri L-3 and own calculations.

Production costs II of organic milk (Figure 4-2) show less difference in costs between FADN and other sources than production costs I. This is mainly due to different ways of accounting for fodder costs. In those countries where fodder costs are market purchased or based on full cost calculations (i.e. Denmark and Germany), no additional costs of land that is needed for fodder production have to be considered. FADN based estimations, however, show land costs of the area needed for fodder production explicitly. Thus, fodder land costs are not included until production costs II are calculated.

Surprisingly, labour costs in the case of other data from Italy are extraordinary high. This cannot be explained by the feeding intensity (which is about the same as for Denmark, 8000 kg, see Figure 4-2) because labour costs usually decrease with production intensity increasing. A reason might be different, more labour intensive housing systems in the case of other costs from Italy.

Figure 4-2: Production costs II of organic milk



For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: EU-FADN DG-Agri L-3 and own calculations.

With the exception of some little differences that could be explained by different accounting methods, it can be stated that FADN estimates for organic milk match the reference data very well. This is true for both absolute values and cost structures.

4.3 Results for wheat

As shown in Figure 4-3, production costs I of organic wheat vary from about 150 to 350 Euro per ton. Whereas FADN data and non-FADN data for Denmark match very well (slightly higher maintenance costs in the case of non-FADN), the figures of the remaining countries match less well.

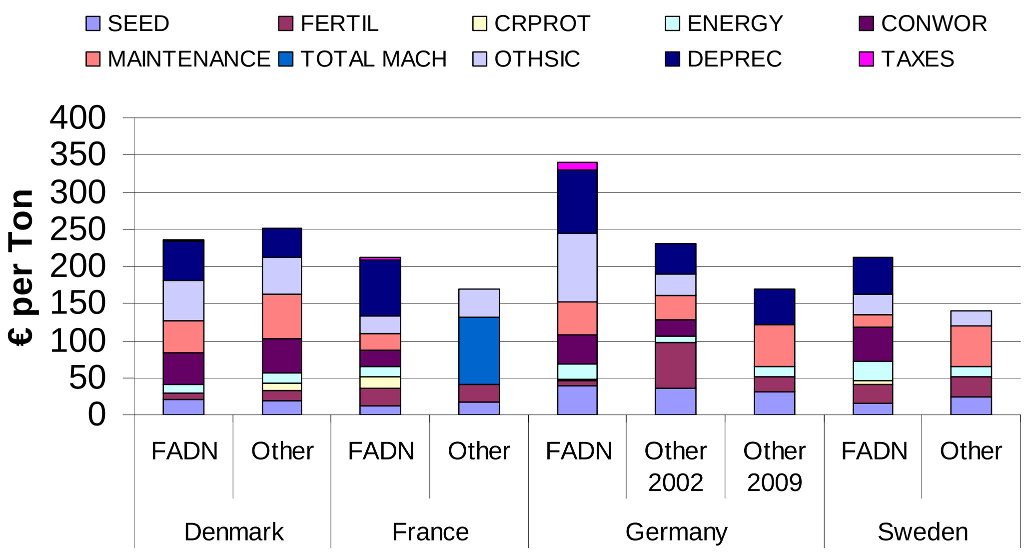
Production costs data from other sources in the case of France are about 50 Euros lower than FADN data. The composition of costs cannot be investigated further since machinery costs from other sources are only given as total costs (crop protection, fuel, etc.).

The biggest differences in absolute cost terms can be observed at the German data comparison. FADN estimates are about 120 Euro per ton higher being compared to other data 2002 and 170 Euro per ton higher being compared to other data 2009. Seed costs are approximately the same for all of the data sets. Fertilizer costs however are the highest for the 2002 data set which can be explained by a different approach of accounting for fertilizer costs (see chapter 3). Costs that cannot be assigned to certain farm activity account for about 100 Euros in the case of FADN estimates. The reason for this might be a lower degree of specialization among organic arable farms being compared to conventional reference farms. Particularly small farms carry out on-farm processing (bakery, butchery, cheese dairy).

Activities such as on-farm processing are directly linked to the way of distributing farm products. In Germany distribution channels for organic farm products are diverse. According to a study throughout Germany by Rahman et al. (2004) 32% of the organic farms surveyed market their products directly (farms > 50 ha UAA: 22%; farms < 50 ha UAA: 40%). Direct marketing activities such as farm shops cause miscellaneous costs that are not assignable to one certain production system.

Swedish FADN estimates are about 60 Euro per ton higher than non-FADN figures. Considering that depreciation costs in the case of non-FADN data are missing, it can be asserted that FADN estimates give a reasonable match to the reference data when this is taken into account.

Figure 4-3: Production costs I of organic wheat

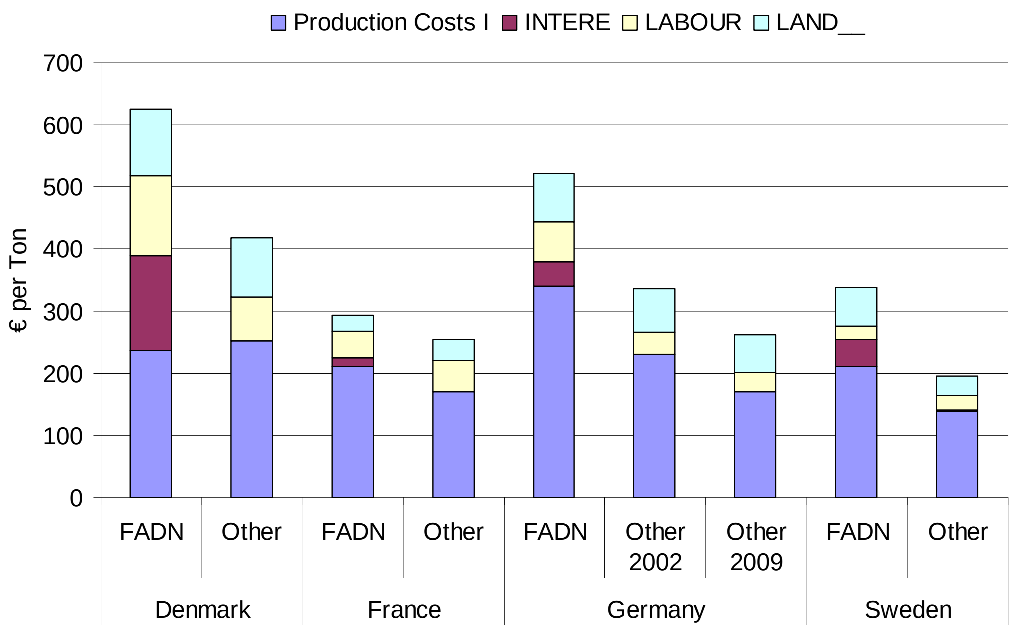


For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: EU-FADN DG-Agri L-3 and own calculations.

Production costs II of organic wheat (figure 4-4) show more or less the same picture as production costs I. Solely the Danish FADN estimates are much higher being compared to other sources´ figures. This is mainly due to capital costs of about 180 Euro per ton, which is mainly determined by the Danish law of inheritance. French costs figures from both sources show a relatively good match in absolute and in compositional terms. German and Swedish data on the contrary show a mismatch.

Figure 4-4: Production costs II of organic wheat



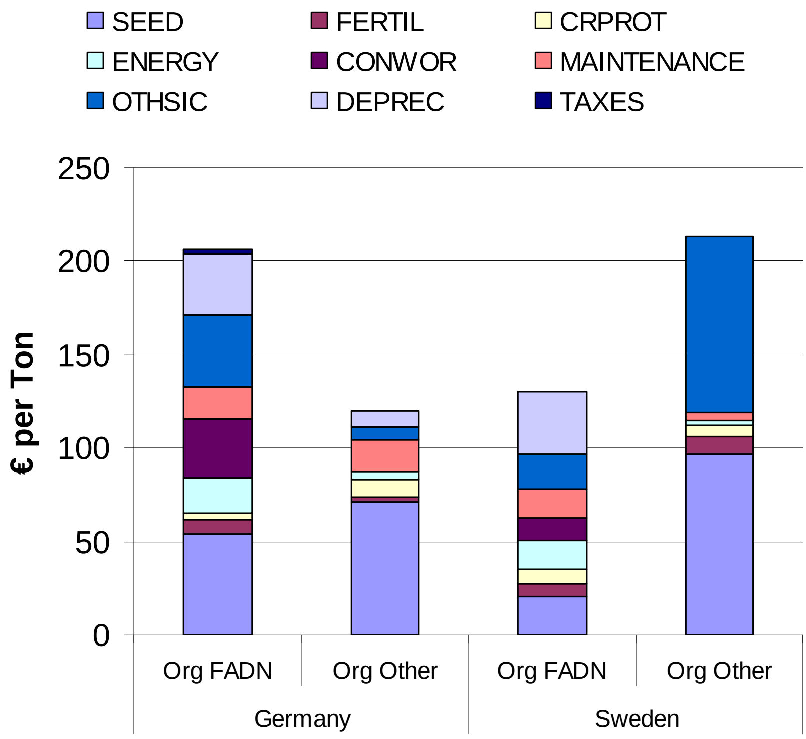
For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: EU-FADN DG-Agri L-3 and own calculations.

4.4 Results for potatoes

Although FADN cost estimates for organic potatoes are less good than for dairy, the results are discussed below. Plausible results of cost estimations are available for Germany and Sweden. Production costs I range between 100 and 200 Euro per ton (see figure 4-5). When organic FADN and organic data from other sources are compared, no clear picture is visible. In the case of Germany organic FADN cost estimates are almost twice as high as costs from other sources, whereas in the case of Sweden production costs from other sources are almost twice as high as FADN estimates. The remarkably high production costs of other sources for Sweden might be due to the inclusion of irrigation costs in other miscellaneous. Why production costs I in Germany are either clearly overestimated by FADN estimates or underestimated by data from other sources cannot be figured out.

Figure 4-5: Production costs I of organic potatoes

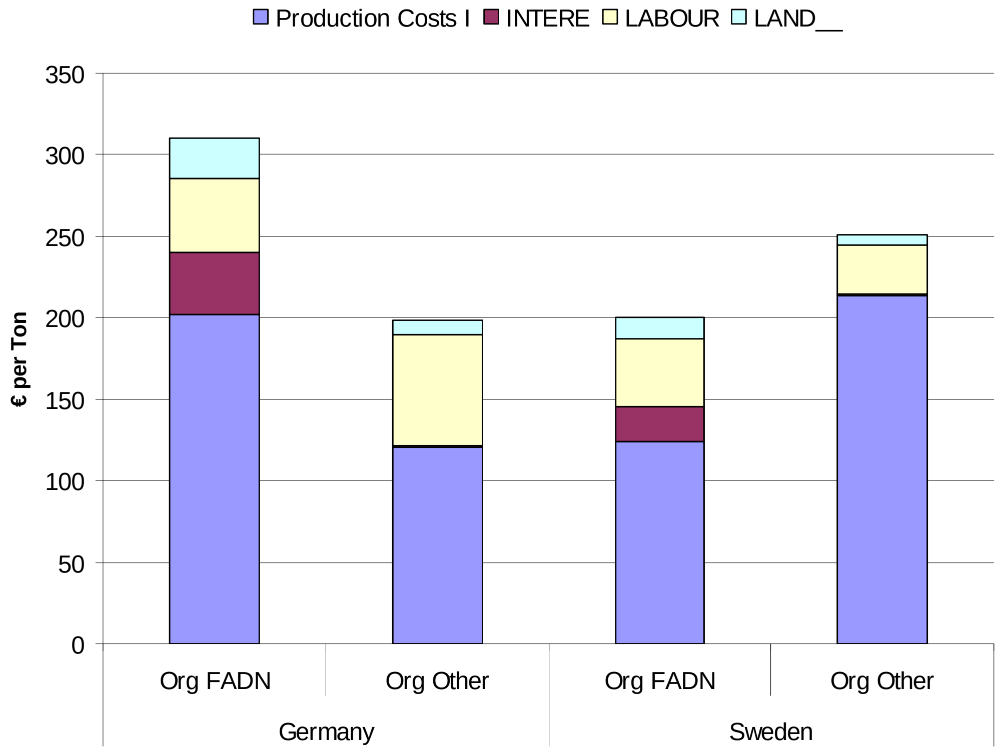


For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: EU-FADN DG-Agri L-3 and own calculations.

As shown in figure 4-6 production costs II of organic potatoes range between 200 and 300 Euro per ton. Viewing them in detail, the differences between FADN and non-FADN costs compared to production costs I get less but are still significant. Especially between the German FADN estimates and German costs from other sources no good degree of match can be observed, neither in absolute nor in compositional terms. Production costs II of Swedish non-FADN data are 50 Euros per ton higher than FADN data. As mentioned above, this might be due to the irrigation costs included.

Figure 4-6: Production costs II of organic potatoes



For interpretation purposes it has to be considered that not all cost categories are available for all products and countries. Detailed information about national data are provided in chapter 3.1.

Source: EU-FADN DG-Agri L-3 and own calculations.

5 Comparison of GECOM estimates for organic and conventional production

This chapter provides a comparison of organic and conventional FADN-based full cost estimations by means of the general cost of production model, and contrasts costs to market prices as well as total returns (market price plus total subsidies) to evaluate profitability.

5.1 Results based on EU FADN

5.1.1 Production costs of milk

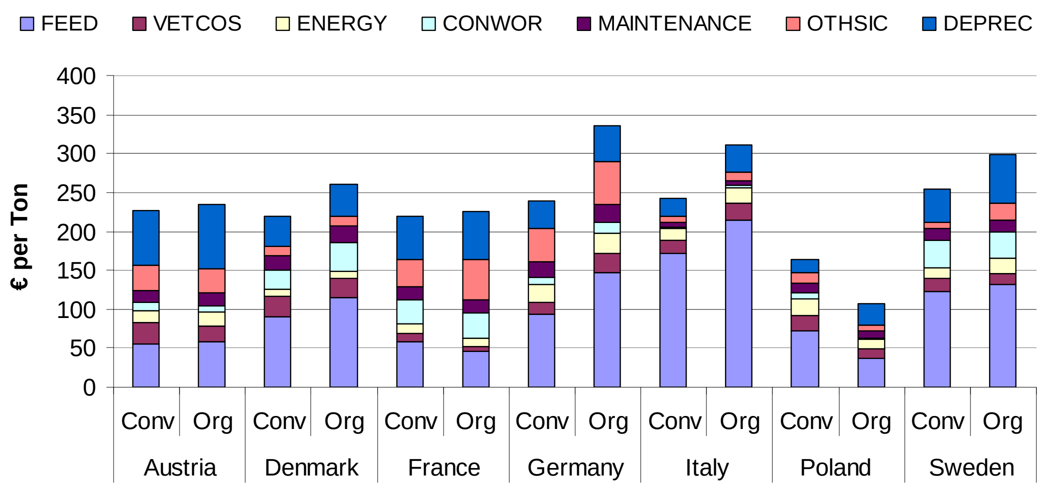
Production costs I of conventional and organic milk are shown in Figure 5-1. For the majority of the old EU member states the costs range from about 200 to 300 Euros. Germany shows the highest costs. Poland as the only new member state shows the lowest costs.

Austrian conventional and organic production structures are almost equal, with slightly higher costs of the organic production. The same applies for France. French organic production figures show surprisingly lower feed costs per ton milk than conventional estimates. Also noticeable are the relatively high depreciation costs in the case of France and (particularly) Austria. Given this fact and the rather low feed costs per output this can be interpreted as an indication of intense production systems.

Viewing the cost estimates of the remaining old EU member states (Denmark, Germany, Italy, Sweden), a clear difference can be seen in total costs between conventional and organic production with higher costs for organic production. This is particularly true for Germany and Italy. This is (especially for Italy) due to higher feed costs and (in the case of Germany) high miscellaneous costs.

Poland with its high conventional feed costs (if compared to Austria or France) on the one hand but low maintenance, depreciation and miscellaneous costs shows by far the lowest costs of all countries with organic costs lower than conventional which might be caused by very extensive organic production systems.

Figure 5-1: Production costs I of milk



Source: EU-FADN DG-Agri L-3.

Production costs II, market prices and total returns of milk are illustrated in the following figure 5-2. Viewing the relations between organic and conventional costs the picture of production costs I has basically been maintained.

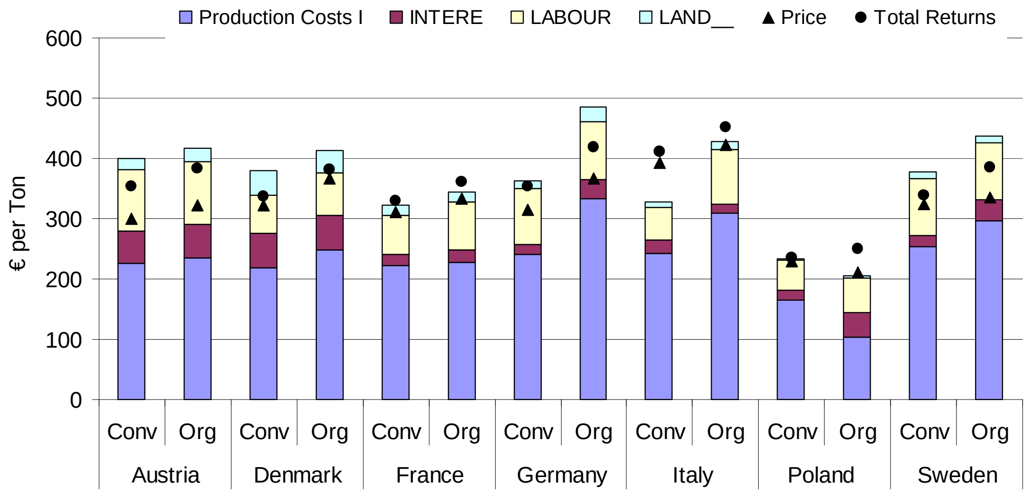
A stronger costs increase for organic than conventional when including imputed costs can be observed in Italy (higher labour costs) as well as Poland and Sweden (higher capital costs) but is extremely strong in the case of Germany. In Germany all of the three factor costs (labour, land, capital) increase more for organic than for conventional production when comparing production costs II and I.

With the exception of Poland the market price for organic milk is higher than for conventional in all of the countries. The highest dairy subsidies are paid in Austria, the lowest in France and Denmark. German organic dairy subsidies are rather high but still aren’t high enough to cover organic production costs, which are about 50 Euro per ton above total returns.

The opposite is the case for Italian conventional production. Total costs per ton are approximately 80 Euro lower than total returns. For the Italian organic production, returns are also above costs, but to a lesser degree than conventional.

Albeit Poland shows an organic market price lower than conventional, total returns are clearly above production costs, which is due to the subsidies paid.

Figure 5-2: Production costs II, market prices and total returns of milk



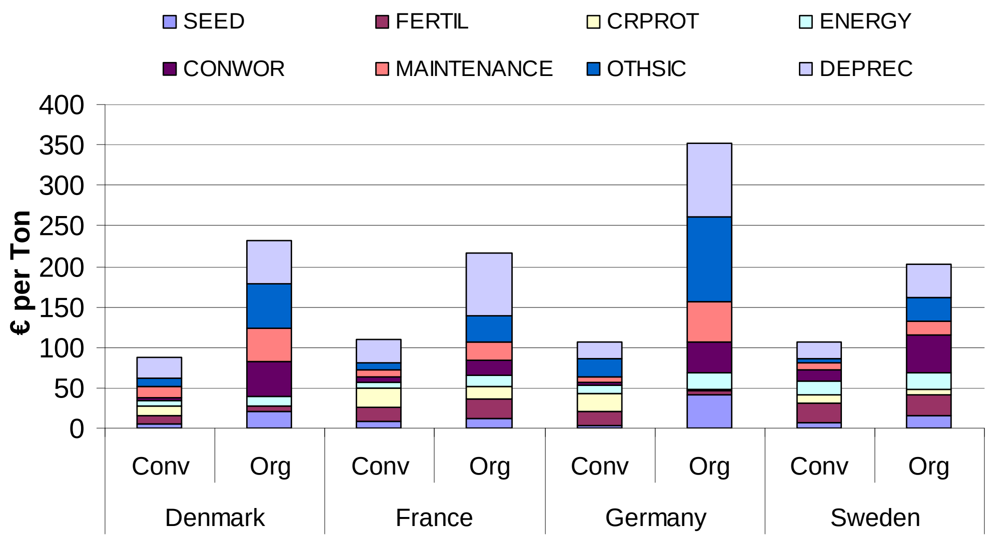
Source: EU-FADN DG-Agri L-3.

5.1.2 Production costs of wheat

Figure 5-3 shows production cost I estimations of wheat. Conventional wheat costs are between 90 and 110 Euro per ton. Organic costs are about 200 Euro for Denmark, France and Sweden and 350 Euro for Germany. As it was the case for the milk data shown previously, the difference between organic and conventional production costs is the highest in Germany. Whereas organic costs are twice as high as conventional in Denmark, France and Sweden, it is at factor 3.5 in Germany. This big difference is again primarily caused by miscellaneous costs of about 100 Euro, but also due to higher organic depreciation, seed and maintenance costs than in most other countries.

With regard to the structure of the costs, it can be asserted that organic costs exceed conventional production in almost all cost categories. Exceptions are “crop protection” in all countries and “fertilizer” costs in Denmark and Germany. Here conventional costs are higher than organic.

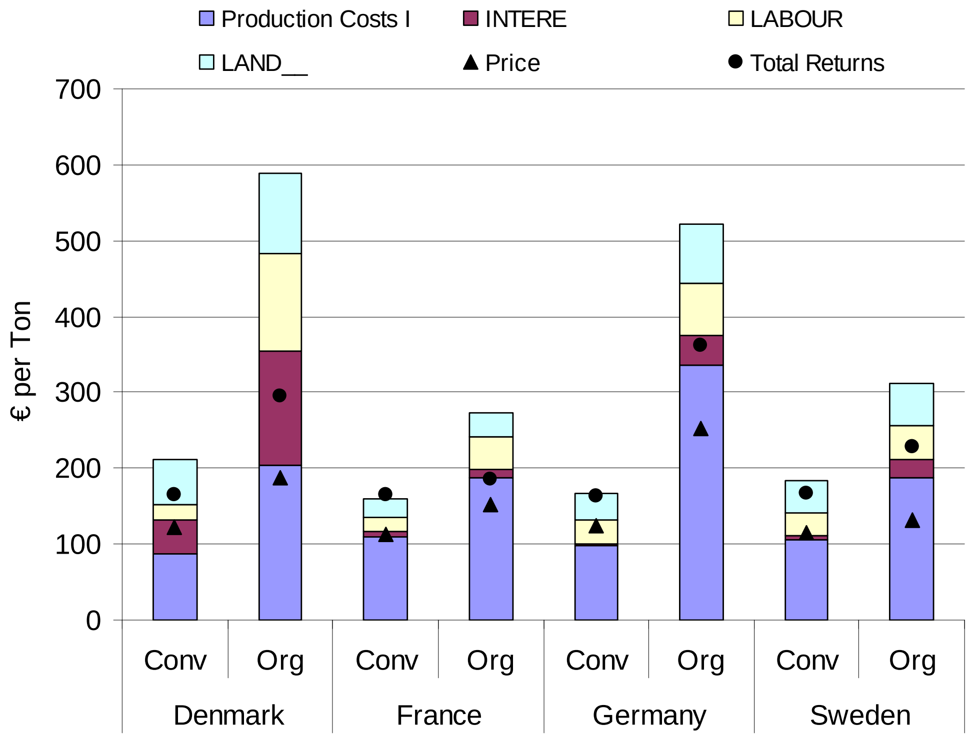
Figure 5-3: Production costs I of organic wheat



Source: EU-FADN DG-Agri L-3.

As illustrated in Figure 5-4, production costs II of wheat show an even more heterogeneous picture than production costs I. This especially applies for organic production costs. Whereas conventional production costs show imputed costs of less than 100 Euro (France, Germany, Sweden) and slightly above 100 Euro per ton (Denmark) respectively, organic imputed costs vary from 90 Euro (France), 110 Euro (Sweden), 170 Euro (Germany) to 400 Euro per ton (Denmark). This leads to conventional production costs II of 160 to 210 Euro per ton and organic production costs II of 280 to 590 Euro per ton.

Figure 5-4: Production costs II, market prices and total returns of organic wheat



Source: EU-FADN DG-Agri L-3.

5.1.3 Production costs of potatoes

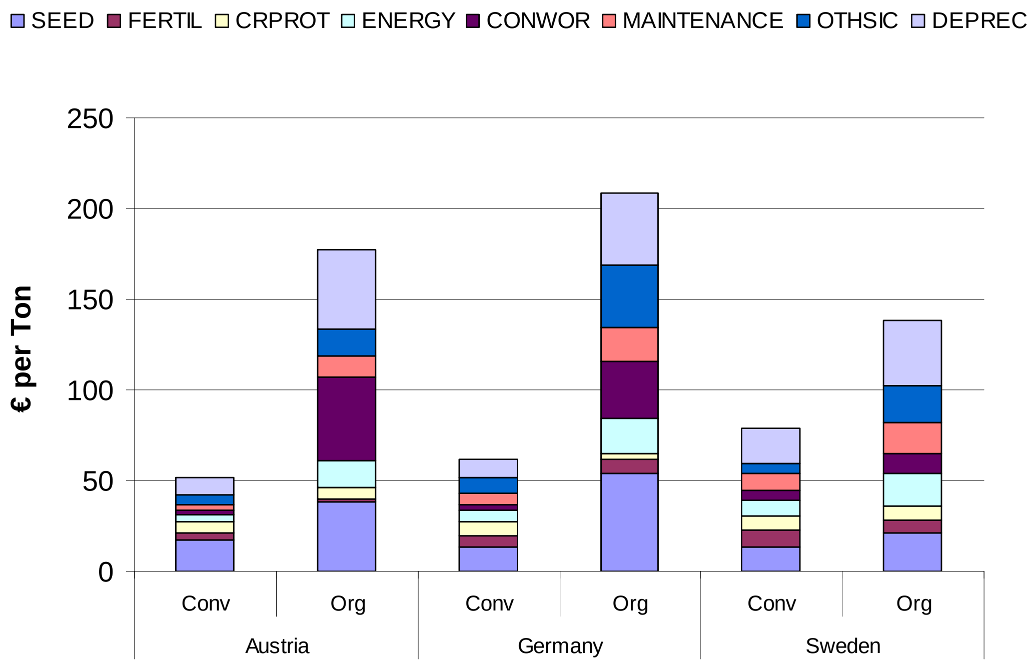
Figure 5-5 shows production costs I of potatoes. Conventional costs range between 50 and 75 Euro per ton and increase by the following order of countries: Austria, Germany, Sweden.

Organic costs are 140 Euro per ton for Sweden, 175 for Austria and 210 for Germany. Viewing cost structures, seed costs account for the biggest share of the total costs in most cases for both conventional and organic production (exceptions are: Austria organic "contract work" and Sweden organic "depreciation").

With 150 Euro per ton Germany again shows the biggest cost difference between conventional and organic production (Austria: 125; Sweden: 70). Conventional cost compositions are more or less the same among all countries. Organic cost compositions however show high variations among countries. Seed costs for instance are in Germany twice as high as in Sweden. Fertilizer and crop protection costs are about the same across countries and production system (org. vs. conv.).

Energy, contract work, maintenance, miscellaneous and depreciation costs are as well much higher for organic production than for conventional (factor two to four in most cases). This might be due to being a lower proportion of potatoes in the rotation for organic (and consequently no economies of scale such as specialist machinery) compared to farms being specialised to a high degree.

Figure 5-5: Production costs I of potatoes



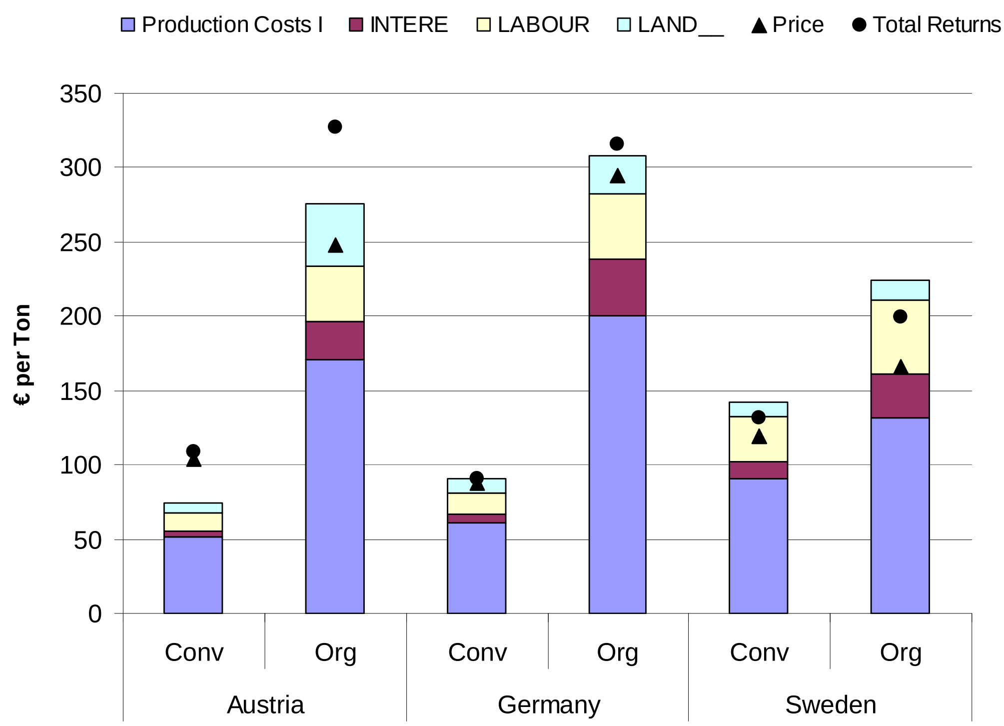
Source: EU-FADN DG-Agri L-3.

Production costs II, market prices and total returns of potatoes are illustrated in Figure 5-6. Conventional costs range from 75 (Austria) to 145 (Sweden) Euro per ton. Organic costs range from 225 (Sweden) to 305 (Germany) Euro per ton.

Particularly noticeable are the differences in land, labour and capital intensity between organic and conventional production. These are the biggest in Austria, followed by Germany and Sweden.

Since subsidies per ton potatoes are much higher for organic than for conventional production in all countries, high production costs can –at least in Austria and Germany- be covered by high total returns (factor three in the case of Austria and Germany if compared to conventional). In Sweden no such big differences can be observed.

Figure 5-6: Production costs II, market prices and total returns of potatoes



Source: EU-FADN DG-Agri L-3.

5.1.4 Production costs of cattle

Figure 5-7 shows production costs I of organic and conventional cattle per livestock unit (LSU). With the exception of Denmark, organic costs are higher than conventional in all countries. Conventional production is more or less at a level of 300 Euro per LSU. Organic production costs range from 200 (Denmark) to 500 Euro per LSU in Germany.

Hence, equal to the results of the previous chapters, Germany shows a comparatively high level of organic production costs. On the contrary, conventional production costs in Germany are the lowest of all six countries illustrated. Consequently, the cost difference between organic and conventional production in Germany is the biggest of all countries. This is again caused by reasonably high miscellaneous costs, which are due to farm-activities like food processing or direct marketing (see chapter 4.2.3). The same might apply for Austria.

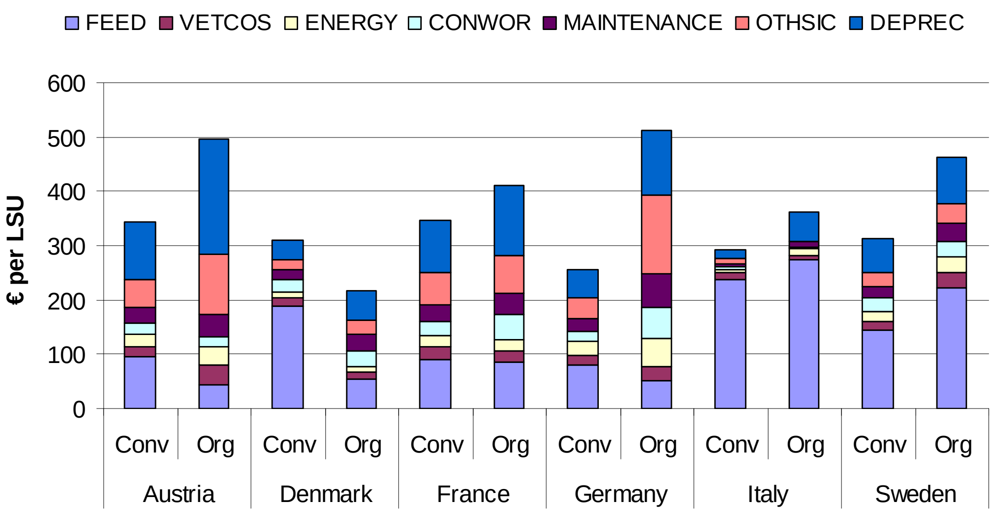
Austria (especially the organic production), France and Germany show significantly higher depreciation costs than Denmark, Italy and Sweden, which is an indication for more capital intensive systems of production in the former countries.

Cost differences between conventional and organic production of about 100 Euro per LSU in Denmark are mainly caused by organic feed costs of about one third compared to conventional feed costs. France shows an average cost picture, in absolute as well as in cost compositional terms, with slightly higher organic costs than conventional.

Italy is an exception in so far as it shows rather low total costs but extraordinarily high feed costs for both organic and conventional production. Hence, feed costs account for more than two thirds of the total costs. Given this fact, combined with low depreciation and maintenance costs, this can be interpreted as an indication of extensive and capital reduced production systems (when for instance being compared to French or Austrian production systems).

Sweden shows the second highest total conventional and the third highest organic costs of all countries. In terms of difference between organic and conventional production as well as cost structure, Sweden is rather mid-ranging.

Figure 5-7: Production costs I of cattle



Source: EU-FADN DG-Agri L-3.

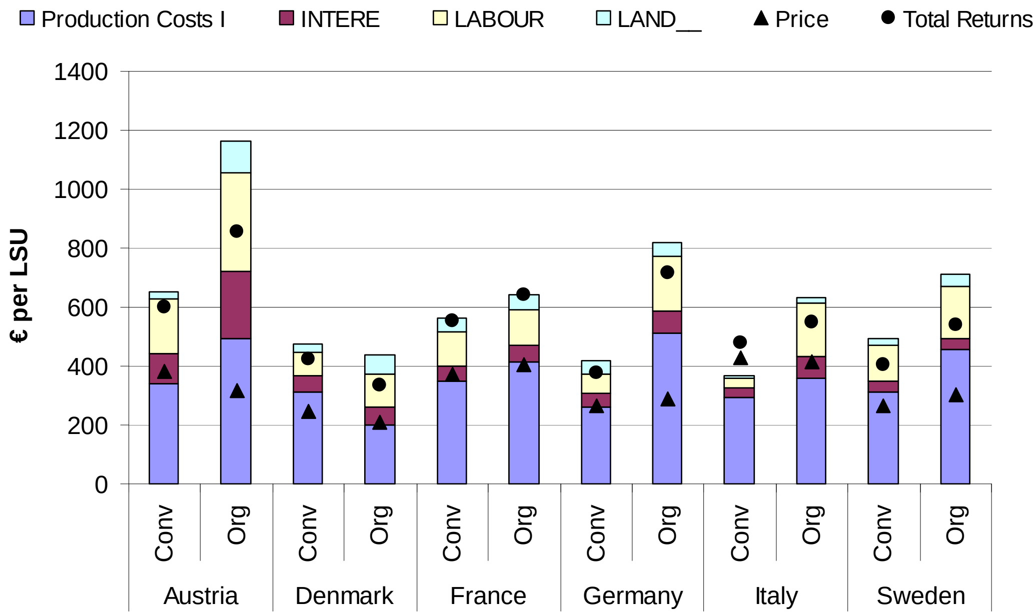
Production costs II of cattle show a slightly modified picture compared to production costs I. With Austria showing higher imputed costs than production costs I for organic production, it has by far the highest organic costs of all countries, which can neither be covered by the (rather similar across all countries) organic market price nor by the total returns, as the sum of price and total subsidies.

What could be observed at production costs I can again be seen here in the case of Denmark: Lower organic than conventional production costs; going along with lower market prices and subsidies. France and Sweden again show the modest picture with mid-range costs (compared to the remaining countries) as well as higher market prices and higher subsidies for the organic production compared to conventional.

What was indicated when viewing production costs I of conventional cattle in Italy is confirmed when viewing production costs II: Very low capital, labour and land costs. As a consequence, feed costs account for more than 50% of conventional production costs II, which is remarkably high. Italy therefore shows the lowest conventional production costs of all countries.

The structure of Italian organic production has slightly changed from production costs I to production costs II. Rather more average labour and capital costs cause imputed costs of more than 200 Euro per LSU. Nevertheless, Italy still shows the second lowest organic production costs II of all countries.

Figure 5-8: Production Costs II, market prices and total returns of cattle



Source: EU-FADN DG-Agri L-3.

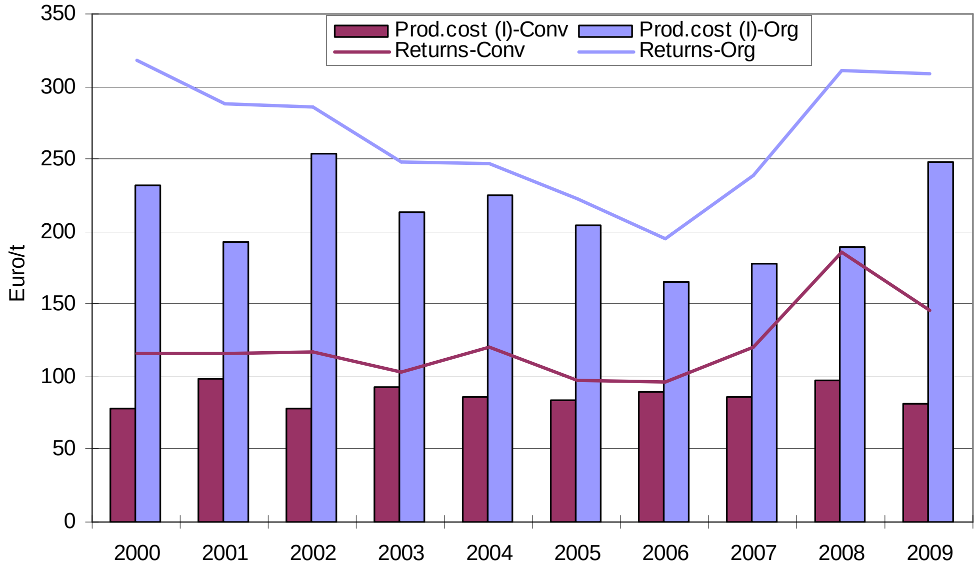
5.2 Production costs of organic farms using the German FADN

5.2.1 Production costs of milk and wheat

For a more detailed analysis the German national FADN is used.[4] First results from the German national FADN are presented comparing the production costs and returns of organic and conventional farms. Time series from 2000 to 2009 for the production costs and returns as well as the average harvest area of wheat for conventional and organic farms are shown in Figure 5-9. It can be seen that the production costs as well as the returns of wheat are much higher for organic farms than for conventional farms. Although, when only looking on the production costs (I) all the costs are covered by market returns for organic as well as conventional farms.[5] While returns for conventional farms are more or less constant over time (except for 2008 where they rise), returns for organic farms constantly decrease until 2006, from where they start to rise again to the former level.

[4] A description of the data base and sample structure is given in Berner et al. (2011).
[5] It has to be noted again that only production costs (I) are illustrated.

Figure 5-9: Production cost (I) and returns of wheat for conventional and organic farms, 2000-09

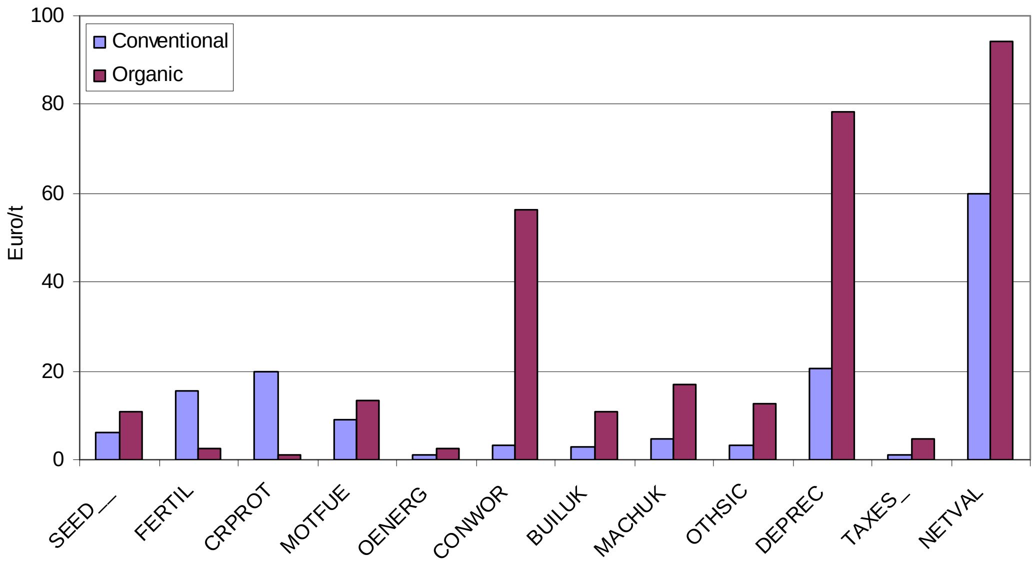


ha	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Organic	10.81	15.35	15.56	13.53	19.66	18.49	20.53	19.38	19.81	18.34
Conventional	34.80	38.91	40.98	43.49	42.64	44.14	45.64	45.83	44.57	48.04

Source: German national FADN and own calculations.

For a better overview of the structure of the production costs, the single cost components and the resulting net value added are illustrated in Figure 5-10 as an average over the last ten years. As expected conventional farms show much higher values for fertilizer and crop protection, whereas organic farms have very high values for contract work and depreciation which leads overall to a higher net value added for organic farms.

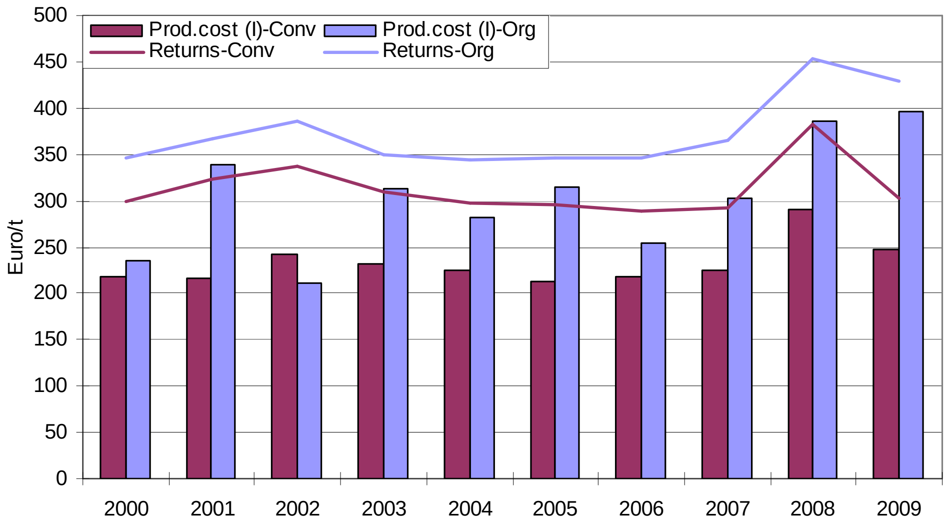
Figure 5-10: Production cost (I) per ton of wheat for conventional and organic farms (Ø 2000-09)



Source: German national FADN and own calculations.

The results for milk production are presented in Figure 5-11. As expected, organic farms show again higher production costs (except for 2002) and returns are about 50 Euro/t higher than those of conventional farms. A small rise in costs and returns can be observed for the last years for both farm types, but returns and costs of organic farms are already decreasing again in 2009.

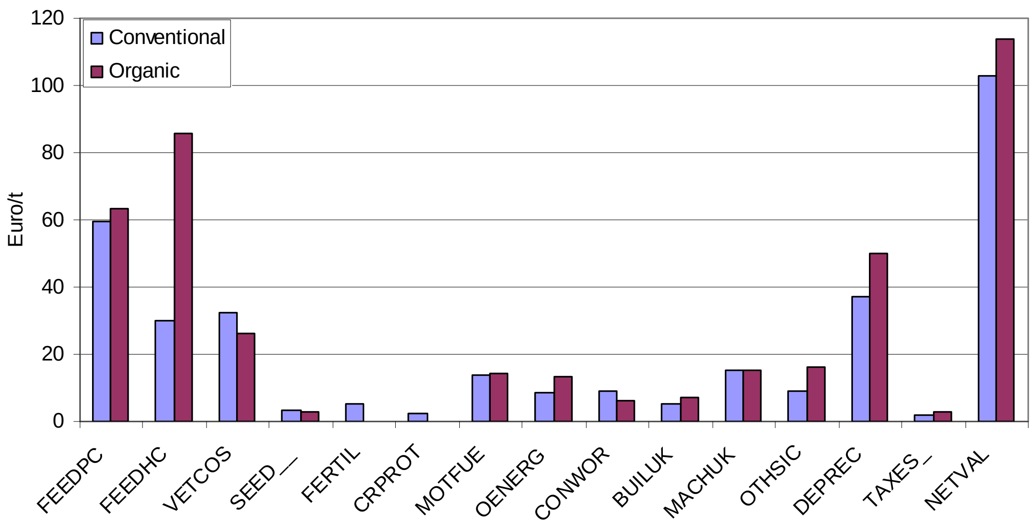
Figure 5-11: Production cost (I) and returns of milk for conventional and organic farms, 2000-09



Source: German national FADN and own calculations.

Detailed costs for milk production are illustrated in Figure 5-12. Here it can be seen that organic farms have much higher costs for home-grown feed and slightly higher costs for purchased feed and depreciation but nevertheless show a slightly higher net value added compared with conventional farms.

Figure 5-12: Production cost (I) per ton of milk for conventional and organic farms (Ø 2000-09)



Source: German national FADN and own calculations.

5.2.2 Impact of outlier elimination of results

As could be seen in the previous chapters, the results for organic farms are not satisfying yet. To improve the results an outlier detection method as described in Kleinhanss (2011) is applied. According to this method, a multivariate outlier can be defined as a case with a large Mahalanobis Distance. In Table 5-1 the number of farms before and after the outlier detection is shown as well as the number of outliers.

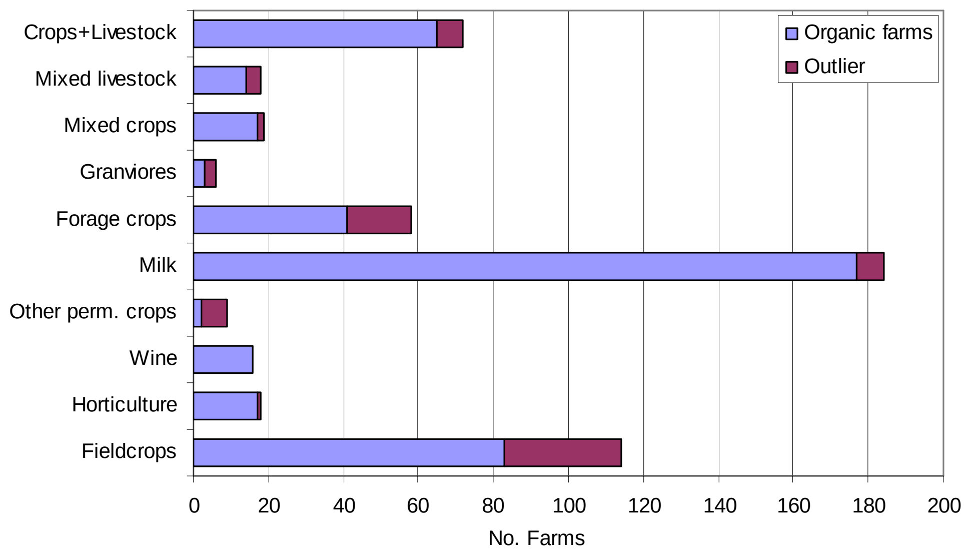
Table 5-1: Number of sample farms before and after outlier detection

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
N (before Outlier)	248	279	334	355	412	446	461	475	515	514
N (after Oulier)	204	223	279	303	343	372	391	394	434	435
No. Outliers	44	56	55	52	69	74	70	81	81	79

Source: German national FADN and own calculations.

In the following graphs the outliers are analyzed more deeply regarding the location of the farms, the size and the type of farming.
In Figure 5-13 the numbers of outlier farms by type of farming compared to all organic farms are illustrated. As can be seen in 2009 most outlier farms are field crop farms (31), followed by forage crop farms (17).

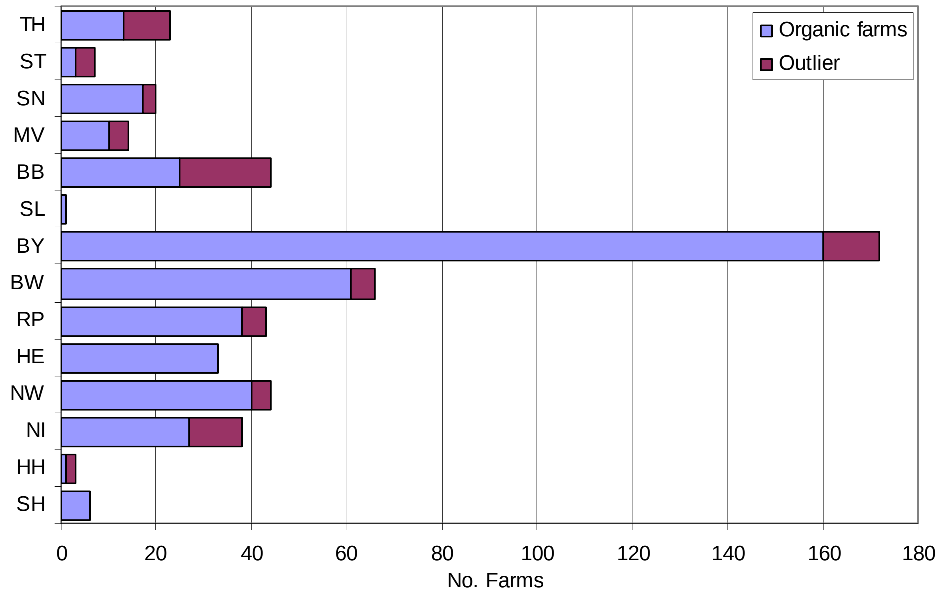
Figure 5-13: Type of farming of outlier farms, 2009



Source: German national FADN and own calculations.

Figure 5-14 shows the outlier farms in 2009 sorted by region. Here the absolute largest number of outlier farms can be found in Brandenburg with 19 outlier farms, followed by Bavaria with 12 outlier farms and Lower-Saxony with 11 outlier farms.

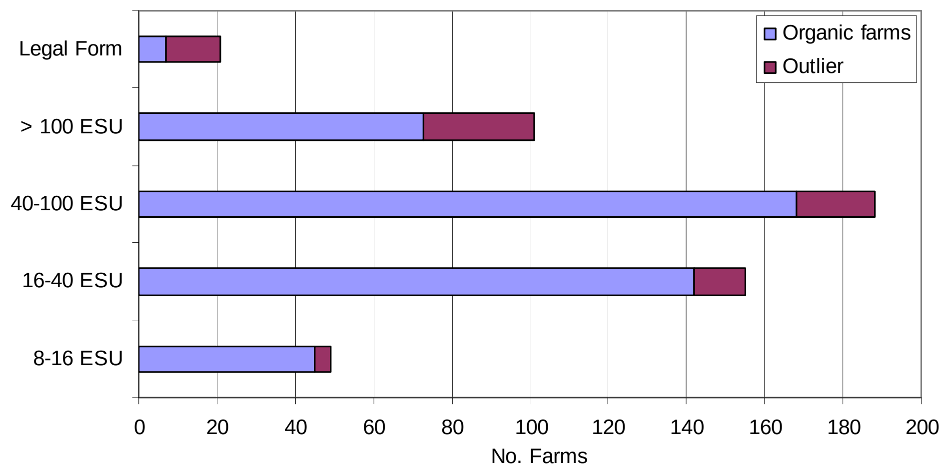
Figure 5-14: Region of outlier farms, 2009



Source: German national FADN and own calculations.

The numbers of outlier farms in 2009 by farm size are shown in Figure 5-15. The absolute largest number of outlier farms can be found for farms greater than 100 ESU, while the relative largest number can be found for legal forms (corporate farms).

Figure 5-15: Farm size of outlier farms, 2009

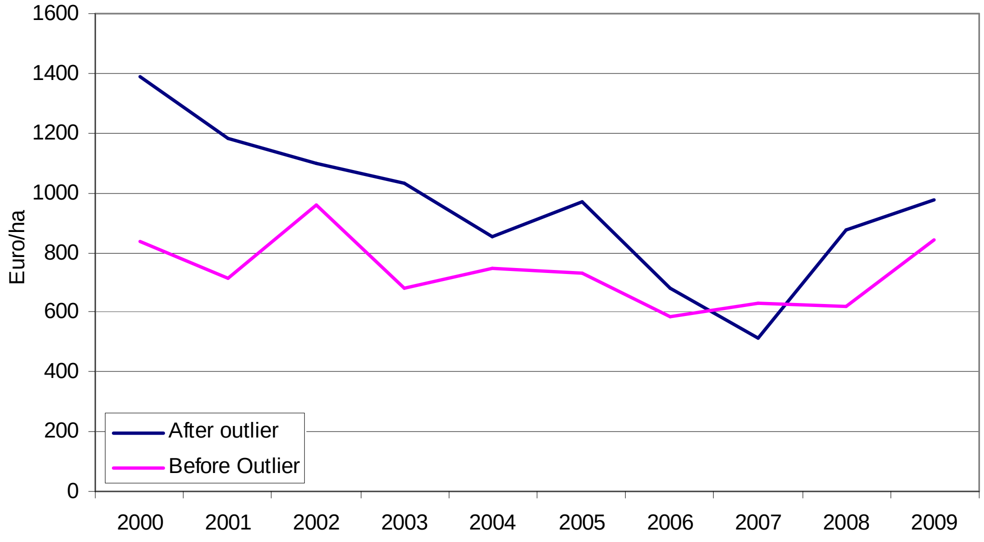


Source: German national FADN and own calculations.

In the following the production costs for the three main products before and after outlier detection are shown.

In Figure 5-16 the production costs of organic wheat are illustrated. It can be seen that after the outlier detection the production costs are higher than before, with the biggest difference in 2000. From there the difference decreases until 2007, where the production costs are a bit lower than before. After that the production costs rise again and are then again higher than before the outlier detection.

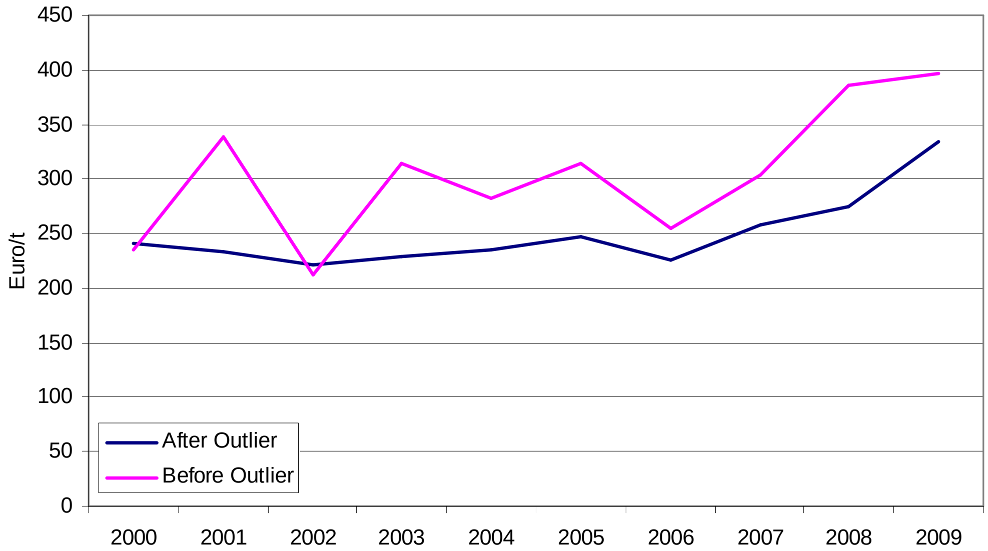
Figure 5-16: Production cost (I) of wheat before and after the outlier detection



Source: German national FADN and own calculations.

The production costs of organic milk before and after the outlier detection are presented in Figure 5-17. Here the improvements from the outlier detection become quite obvious as before, the production costs are rather volatile and after the outlier detection they are a bit lower and much smoother.

Figure 5-17: Production cost (I) of milk before and after the outlier detection



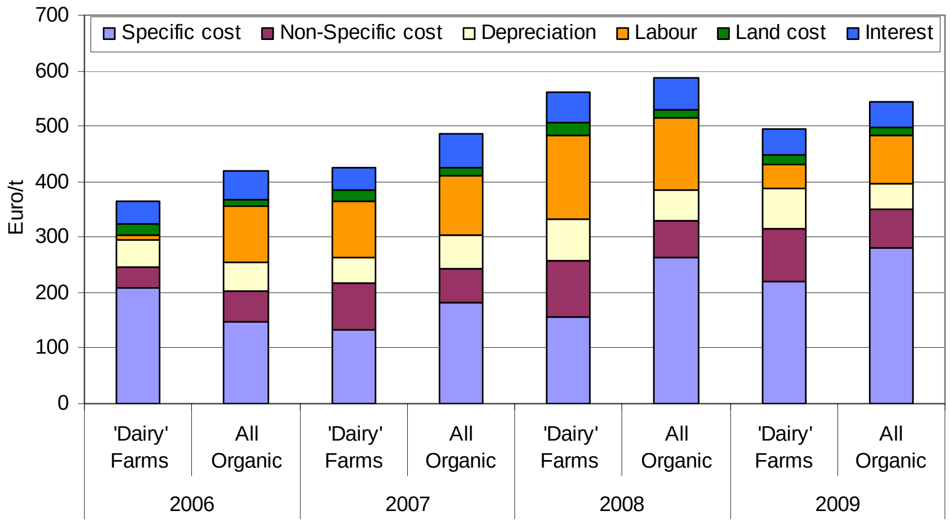
Source: German national FADN and own calculations.

5.2.3 Impact of specialisation on production costs of organic milk

For the identification of homogenous farms mostly the possibility of specialized farms is considered. However, organic farms are usually rather heterogeneous, so that this specification can't be applied. Therefore a routine taking the output into account is implemented. This routine calculates the overall output as a sum of all individual outputs. All farms where the share of one individual output e.g. milk equals 60% or more of the overall output of this farm are considered as homogenous farms.

These calculations are done for milk and in that way between 133 and 160 farms are identified as homogenous farms for different years. The results can be seen in Figure 5-18, where the production costs (I) plus the costs for labour, land and interest for these homogenous and the average of all organic farms are illustrated.

Figure 5-18: Production cost (I) and factor costs for organic (homogenous) farms



Source: German national FADN and own calculations.

As can be seen in Figure 5-18, the farms considered as homogenous show for all years overall lower costs than the average of all organic farms.[6] When the results for 2006 are ignored, the homogenous farms have lower specific costs than the average of all organic farms. When looking on the factor costs, the cost structure is almost similar, only in 2006 and 2007 the interest and labour costs for homogenous farms are a bit lower. The results thus indicate a cost advantage of farms specialised in organic milk production.

[6] The coefficient for labour for homogenous farms is insignificant in 2006.

6 Environmental impacts of organic farming – an analysis for England and Wales based on indicators derived from FADN

6.1 Introduction

In this report the possibility is investigated of using farm economic data (such as the Farm Business Survey in England and Wales) to provide environmental indicators on which farms can be assessed. A selection of environmental indicators was made based upon previous research. These indicators were investigated using Farm Business Survey (FBS) data from 2008-09 and 2009-10 (Defra 2008-09; Defra 2009-10).[7] The raw data was used in this analysis and therefore no weighting factors have been applied.

The indicators and the FBS variables (in bold) used to calculate them are listed below:

- *Fertiliser use* – Cost of fertiliser per ha utilisable agricultural area (UAA) and per (£ or €) output
  - **Agriculture.fertiliser.costs/UAA** and **agriculture.fertiliser.costs/output.from.agriculture.excl.subsidies**

- *Pesticide use* – Cost of pesticide per ha UAA and per (£ or €) output
  - **Agriculture.crop.protection.costs/UAA** and **agriculture.crop.protection.costs/output.from.agriculture.excl.subsidies**

- Purchased feed per LU
  - **Purchased.feed.fodder/UAA** and **purchased.feed.fodder/LU**
  - **(feedingstuffs.costs.purchased-fodder.costs)/UAA** and **(feedingstuffs.costs.purchased-fodder.costs)/LU** to give purchased concentrate costs per UAA and LU

- An *intensification indicator* (EEA, 2005) consisting of the sum of fertiliser cost, pesticide cost and purchased concentrate cost divided by UAA
  - **(Agriculture.fertiliser.costs+agriculture.crop.protection.costs+(feedingstuffs.costs.purchased-fodder.costs))/UAA**

- Monetary receipts from agri-environmental schemes per ha UAA
  - **Agri.environment.schemes.payments/UAA**

- Shannon crop diversity index
  - Calculated as $H = -\sum p_i \ln(p_i)$
  - Where each p_i is the area fraction of each individual crop (i.e the area of the crop over the total cropping area). Thus the result will sum over all crops

[7] Many thanks to Simon Moakes (Aberystwyth University) for his assistance with FBS data and explanations of FBS variables and for running the statistical tests on SPSS.

considered. For example, if a farm has 20ha of crops, 15ha wheat and 5 ha oats. The Shannon diversity index would be: H=-(15/20)ln(15/20) – (5/20)ln(5/20). The higher the result, the greater the diversity (one single crop will give H=0).
  - The area fractions are calculated as: **barley.area/total area considered**, **beans.area/ total area considered**, **horticulture.area/ total area considered**, **oilseed.rape.area/ total area considered**, **peas.area/ total area considered**, **potatoes.area/ total area considered**, **permanent.grass.area/ total area considered**, **sugar.beet.area/ total area considered**, **wheat.area/ total area considered** where total area considered was calculated as **total area considered = barley.area+ beans.area+ horticulture.area+ oilseed.rape.area+ peas.area+ potatoes.area+ permanent.grass.area+ sugar.beet.area+ wheat.area**. This area was used as the crop areas including main crops and multiple cropping whereas UAA and other total areas calculated in the calcdata section of FBS only use main crop areas and so using these as denominators could result in a negative Shannon index. Farms with no land in any of these categories were excluded from the sample.

- Average number of livestock units (LUs) per ha of forage area
  - For UK there may be issues with regards to this calculation where common land has been used for farming.
  - **LU/(forage.grazing.fallow.area-fallow.area)**
  - **Grazing LU/(forage.grazing.fallow.area-fallow.area)**

- Proportion of land that is permanent pasture, woodland, fallow land
  - **(fallow.area+permanent.grass.area+woodland.area.cam)/(UAA+woodland .area.cam+net.land.hired.in)**

In all cases, where the denominator is zero giving a divide by zero error, the farm is excluded from the sample for that particular indicator.

The use of UAA as a denominator can be seen as giving a bias towards extensive farming as extensive systems are likely to have a higher denominator, giving a lower total value for the indicator and implying a lower environmental impact. This is seen as not taking into account potentially lower yields in extensive farming that may therefore require a higher land area to produce the same amount of produce as less extensive farms. Thus, the financial output is also used as denominator in some cases. The financial output (i.e income from agricultural activities) can be used as a proxy for production as yield cannot be used given the difficulty in equating a tonne of potatoes as opposed to a tonne of milk or wheat. Output excluding subsidies is used in this study as subsidies do not tend to vary with level of production and so this is deemed to be the best proxy for production levels.

For each indicator the mean and median are quoted as well as the minimum, maximum, standard deviation and sample size. Some indicators give divide by zero errors for some farms (e.g where the farm has zero UAA or its output from agriculture excluding subsidies is zero) and these are excluded from those samples. The means of ratios were calculated by taking the ratio for each individual farm and then averaging over all of the farms i.e. taking mean(A/B) rather than mean(A)/mean(B). This approach was taken as it is the approach which must be taken in calculating the medians, maxima and minima and so the methodological approach is consistent across the main descriptive statistics used. Also, calculating the mean in this way gives each farm equal weighting. It will mean, however, that farms with larger values for the ratios will result in a larger overall mean than id mean(A)/mean(B) were used but this is balances by also taking the median which is much less susceptible to outliers. Organic and conventional systems across all farm types are compared for each indicator and then the data are split into the robust farm types (cereals, general cropping, horticulture, pigs, poultry, dairy, LFA [less favoured area] grazing livestock, lowland grazing livestock, mixed and "other" farms) and the mean and median for each indicator are calculated. These are also split into organic and conventional where possible. However following the disclosure requirements for DEFRA samples of 5 farms or fewer cannot be used and these cases are indicated in the tables by the words "insuff. data". There are also some cases where, for a specific farm type, no organic farms were sampled. These are indicated in the tables by the words "none". The organic and conventional farms for each farm type are compared to see whether any apparent differences are statistically significant. Where "all farms" are analysed these include organic, conventional and in-conversion farms. Conventional and organic farms have then be focussed on for the more detailed analysis. The statistical tests for significant differences are only carried out at the farm-type level as different farm types can have very different profiles for, for example fertiliser use, and so comparing across all organic farms or all conventional farms would lose the details of these.

Two approaches have been taken to assessing the significance of any apparent difference in performance on each of the indicators between organic and conventional farms of each farm type. A two-tailed t-test has been used to compare organic and conventional farms (Levene's test was carried out to evaluate whether or not the variances were equal and then the appropriate p-value was taken based on this). This is a commonly used test for comparing two samples of data to see whether they differ significantly. However, one of the assumptions of the t-test is that the data has a Gaussian (also known as normal) distribution. In the case of FBS data broken down into farm type this assumption does not always hold true. The data were therefore also evaluated using a non-parametric test, the Mann-Whitney test. This essentially compares medians (rather than means as in the t-test) and so is less likely to be influenced by outliers and does not assume a Gaussian distribution for the data. The Mann-Whitney p-values quoted here are based on the asymptotic significance as the exact significance test was too demanding of computing power and so could not be completed. This is a common issue in calculating the exact significance for Mann-Whitney tests. The asymptotic significance, however, is most accurate for large sample sizes whereas the samples considered here are generally very small and so these results must be viewed with some caution. Where the results of both tests agree there is very strong assurance that the result is accurate. Where they disagree the Mann-Whitney test has been assumed to be the more accurate as its assumptions seem better suited to this data set despite the potential issue in using asymptotic significane. In all of the tables showing the statistical results *** represents significance at the 0.5% level, ** represents significance at the 1% level, * represents significance at the 5% level and N.S indicates that no statistical significance was found.

The results of this analysis are presented below in the discussions of each separate indicator.

6.2 Fertiliser costs per UAA and per output

Table 6-1 shows the figures for 2009-10. It can be seen from this that there are a few outliers with high fertiliser spend (the means exceed the medians by a large amount). It appears that organic farms in general have lower fertiliser costs than conventional farms. A negative value for the ratio fertiliser cost/output is obtained where the output from agriculture excluding subsidies is negative.

Table 6-1: Fertiliser cost 2009/10 across all farms and then split into organic and conventional farms.

	Fertiliser cost/UAA (£/ha)		**Fertiliser cost/output (£/£)**	
average	574.65		0.0856	
Median	80.41		0.0645	
	Conventional	**Organic**	**Conventional**	**Organic**
Average	615.52	179.28	0.0924	0.0128
Median	92.13	0.00	0.0712	0.0000
Min	0.00	0.00	-0.0503	0.0000
Max	77860.00	20581.21	0.6182	0.1451
Stdev	3685.09	1704.53	0.0839	0.0263
Sample size	2253	190	2275	190

The full data set for this indicator is given in Appendix A. It can be seen from this that there is good agreement between the years 2008-09 and 2009-10.

Considering individual farm types, it can be seen from Table 6-2 and Appendix A that horticultural farms spend large amounts on fertiliser per UAA whereas poultry farms use the least fertiliser per UAA and costs per UAA are also low for pig farms and both types of grazing farms. Considering costs per financial output (Appendix A), poultry and pig farms again show low fertiliser costs per output but with higher costs for cereals and general cropping farms. It can also be seen that LFA grazing livestock farms have higher fertiliser costs per output (possibly due to lower outputs).

Table 6-2: Comparison of the median fertiliser cost/UAA (£/ha) for each robust farm type for 2009/10.

Farm type	Cereals	General cropping	Horti-cultural	Pigs	Poultry	Dairy	LFA grazing livestock	Lowland grazing livestock	Mixed
Median fertiliser cost/UAA	149.44	154.81	311.73	0	0	123.9	32.34	27.58	86.56
Mean fertiliser cost/UAA	150.79	164.84	5702.8	37.09	10.10	129.4	43.36	46.80	86.74

The statistical significance of these results for both years is investigated in Tables 6-3 and 6-4. These show the mean and median fertiliser costs per UAA and per financial output for conventional (left hand side, marked CF) and organic (right hand side, marked OF) farms and the results of the t-test and Mann-Whitney U test. It can be seen from these that there is good agreement that fertiliser cost (whether per UAA or per financial output) does differ significantly between organic and conventional farms for all farm types. Only for horticultural farms in 2009/10 does there appear to be a slightly lower significance, which may be due to small organic sample sizes.

Table 6-3: Fertiliser cost /UAA (£/ha), significance of differences between organic and conventional farms

Farm type	Cereals		General cropping		Horticulture		Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample size	362	14	186	12	193	8	387	52	532	41	253	33	201	22
08/09 mean	107	10	127	12	6187	10	135	13	42	8	46	3	80	12
08/09 t-test	***		***		***		***		***		***		***	
08/09 median	104	3	110	2	348	0	122	0	32	0	31	0	74	2
08/09 Mann-Whitney	***		***		***		***		***		***		***	
09/10 sample size	356	17	197	12	200	10	397	51	252	41	253	32	185	23
09/10 mean	158	11	175	19	5897	3246	145	8	47	7	53	6	96	13
09/10 t-test	***		***		N.S		***		***		***		***	
09/10 median	156	0	158	9	365	21	136	0	39	0.6	32	0	93	0
09/10 Mann-Whitney	***		***		*		***		***		***		***	

Indicator results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test. *** represents significance at the 0.5% level, ** represents significance at the 1% level, * represents significance at the 5% level and N.S indicates that no statistical significance was found.

Table 6-4: Fertiliser cost/output (£/£) ,significance of differences between organic and conventional farms

Farm type	Cereals		General cropping		Horticulture		Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample	362	14	186	12	194	8	387	52	532	41	253	33	201	22
08/09 mean	0.124	0.018	0.091	0.006	0.040	0.003	0.053	0.005	0.079	0.020	0.058	0.006	0.074	0.020
08/09 t-test	***		***		*		***		**		***		***	
08/09 median	0.115	0.004	0.082	0.003	0.027	0.000	0.048	0.000	0.081	0.000	0.005	0.000	0.067	0.002
08/09 Mann-Whitney	***		***		***		***		***		***		***	
09/10 sample	356	17	197	12	201	10	397	51	525	41	253	32	185	23
09/10 mean	0.201	0.021	0.141	0.015	0.036	0.024	0.060	0.004	0.083	0.020	0.060	0.008	0.097	0.016
09/10 t-test	***		***		N.S		***		***		***		***	
09/10 median	0.198	0.000	0.132	0.003	0.027	0.005	0.054	0.000	0.076	0.001	0.046	0.000	0.076	0.000
09/10 Mann-Whitney	***		***		*		***		***		***		***	

Indicator results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

6.3 Crop protection costs per UAA and per output

Table 6-5 shows the data for 2009-10 showing the mean and median across all farms and then comparing all organic to all conventional farms. As there were for fertiliser costs, there are outliers with high expenditure which skew the mean towards larger values compared with the median. Also, again it appears that organic farms have lower spend (implying lower use) than conventional farms.

Table 6-5: Crop protection cost 2009/10 across all farms and split into organic and conventional farms.

	Crop protection cost/UAA (£/ha)		**Crop protection cost/output (£/£)**	
average	125.66		0.0368	
Median	10.52		0.0067	
	Conventional	**Organic**	**Conventional**	**Organic**
Average	133.49	27.93	0.0400	0.0019
Median	15.19	0.00	0.0083	0.0000
Min	0.00	0.00	0.0000	0.0000
Max	12435.59	4382.02	0.4105	0.0642
Stdev	571.41	318.94	0.0587	0.0071
Sample size	2253	190	2275	190

Appendix B shows the full data set for crop protection costs/UAA and crop protection costs/output. As is the case for the fertiliser costs indicator, it can be seen that there is good agreement between the data for 2008-09 and 2009-10.

From Table 6-6 and Appendix B, it can be seen that horticultural farms again have the highest spend in general for crop protection per UAA and that pig, poultry and grazing livestock farms (LFA and lowland) have lower spend as would be expected since they are unlikely to grow large amounts of crops to require protection. Cereals and general cropping farms have the highest crop protection costs per financial output and poultry farms have the lowest.

Table 6-6: Comparison of the crop protection cost/UAA (£/ha) for each robust farm type for 2009/10.

Farm type	Cereals	General cropping	Horti-cultural	Pigs	Poultry	Dairy	LFA grazing livestock	Lowland grazing livestock	Mixed
Median crop protection cost/UAA	103.02	114.38	405.96	0	0	7.4	0.43	1.67	35.5
Mean crop protection cost/UAA	101.99	128.41	1043.08	37.96	9.77	15.66	1.96	7.71	48.99

The statistical significance of these results is investigated in Tables 7 and 8. These show the mean and median crop protection costs for conventional (left hand side) and organic (right hand side) farms and the results of the t-test and Mann-Whitney U test. It can be seen from these that crop protection costs differ significantly across the farm types whether the denominator is UAA or financial output and that organic farms have lower costs suggesting lower usage.

Table 6-7: Crop protection cost/UAA (£/ha), significance of differences between organic and conventional farms

Farm type	Cereals		General cropping		Horticulture		Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample size	362	14	186	12	193	8	387	52	532	41	253	33	201	22
08/09 mean	107	4	145	14	1064	45	18	0	2	0	8	0	54	4
08/09 t-test	***		***		***		***		***		***		***	
08/09 median	107	0	124	3	413	0	11	0	0	0	3	0	46	0
08/09 Mann-Whitney	***		***		***		***		***		***		***	
09/10 sample	356	17	197	12	200	10	397	51	525	41	253	32	185	23
09/10 mean	107	2	138	13	1062	491	18	0	2	0	9	1	54	6
09/10 t-test	***		***		N.S		***		***		N.S		***	
09/10 median	105	0	120	9	430	0	11	0	1	0	3	0	42	0
09/10 Mann-Whitney	***		***		***		***		***		***		***	

Indicator results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

Table 6-8: Crop protection cost/output (£/£), significance of differences between organic and conventional farms

Farm type	Cereals		General cropping		Horticulture		Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample	362	14	186	12	194	8	387	52	532	41	253	33	201	22
08/09 mean	0.123	0.005	0.099	0.007	0.028	0.003	0.007	0.000	0.004	0.000	0.009	0.001	0.043	0.004
08/09 t-test	***		***		***		***		***		***		***	
08/09 median	0.115	0.000	0.093	0.003	0.013	0.000	0.004	0.000	0.002	0.000	0.005	0.000	0.042	0.000
08/09 Mann-Whitney	***		***		***		***		***		***		***	
09/10 sample	356	17	197	12	201	10	397	51	525	41	253	32	185	23
09/10 mean	0.135	0.004	0.105	0.007	0.028	0.005	0.007	0.000	0.004	0.000	0.008	0.002	0.046	0.004
09/10 t-test	***		***		***		***		***		***		***	
09/10 median	0.128	0.000	0.102	0.006	0.013	0.000	0.004	0.000	0.002	0.000	0.004	0.000	0.044	0.000
09/10 Mann-Whitney	***		***		***		***		***		***		***	

Indicator results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

6.4 Purchased feed cost per UAA and per LU

Again, it can be seen (Table 6-9) that some outliers with particularly high purchased feed costs skew the mean towards higher costs compared with the median. It should be noted that these figures include cereals, horticultural and general cropping farms although these are likely to only have small numbers of livestock. Appendix C shows the results for purchased feed per UAA and purchased feed per livestock unit (LU). Again there is good agreement over the two years.

Table 6-9: Purchased feed cost 2009/10 across all farms and split into organic and conventional farms

	Purchased feed cost/ UAA (£/ha)		**Purchased feed cost/LU (£/LU)**	
average	4253.18		227.60	
Median	66.46		119.12	
	Conventional	**Organic**	**Conventional**	**Organic**
Average	4644.88	380.36	231.36	191.01
Median	69.53	46.98	123.35	73.14
Min	0	0	0	0
Max	3559626.67	23958.84	5303.35	2758.22
Stdev	88190.29	1818.70	413.73	302.46
Sample size	2253	190	1833	177

Considering each farm type in turn (Table 6-10 and Appendix C) , the purchased feed costs are particularly high on poultry farms (both per UAA and per LU) and pig farms (although it should be noted that for both of these was limited/no organic data and so the results over all pig/poultry farms generally only include conventional production), whereas lowland grazing livestock farms in particular have lower purchased feed costs with LFA grazing livestock farms giving slightly higher purchased feed costs and dairy farms having higher purchased feed costs than grazing livestock farms but lower than pig and poultry farms.

Table 6-10: Comparison of the Purchased feed cost per LU (£/LU) for each robust farm type for 2009/10.

Farm type	Pigs	Poultry	Dairy	LFA grazing livestock	Lowland grazing livestock	Mixed
Median Purchased feed cost per LU	594.78	592.73	341.96	103.25	67.34	80.22
Mean purchased feed cost per LU	528.67	1173.39	345.64	117.42	92.60	200.72

The statistical significance of these results is investigated in Tables 6-11 and 6-12. These show the mean and median purchased feed costs for conventional (left hand side) and organic (right hand side) farms per UAA (Table 6-11) and per livestock unit (Table 6-12) and the results of the t-test and Mann-Whitney U test. It can be seen from these that there is less of a significant difference between organic and conventional farms with regards to purchased feed costs than there is for fertiliser and crop protection costs. For dairy farms the purchased feed cost per livestock unit is slightly higher for organic than for conventional farms but this is generally not significant (or only significant at a low confidence level) and probably reflects higher organic feed prices rather than greater use of purchased feed. For lowland grazing livestock there is a more strongly significant difference with organic farms having lower purchased feed costs. This is also reflected in LFA grazing livestock farms although with slightly lower significance. In general the results for mixed farms are not significantly different between organic and conventional farms.

Table 6-11: Purchased feed cost /UAA (£/ha), significance of differences between organic and conventional farms

Farm type	Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample	387	52	532	41	253	33	201	22
08/09 mean	728	579	120	77	179	40	386	294
08/09 t-test	*		*		N.S		N.S	
08/09 median	651	546	88	56	84	20	85	34
08/09 Mann-Whitney	*		***		***		N.S	
09/10 sample	397	51	525	41	253	32	185	23
09/10 mean	703	549	123	68	188	30	294	483
09/10 t-test	*		***		N.S		N.S	
09/10 median	633	511	91	44	90	11	294	44
09/10 Mann-Whitney	**		***		***		N.S	

Indicator results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

Table 6-12: Purchased feed cost/LU (£/LU), significance of differences between organic and conventional farms

Farm type	Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample	387	52	532	41	253	33	201	22
08/09 mean	354	414	117	97	101	42	217	110
08/09 t-test	*		N.S		***		N.S	
08/09 median	344	425	104	76	73	21	91	31
08/09 Mann-Whitney	*		*		***		*	
09/10 sample	397	51	525	41	253	32	185	23
09/10 mean	341	380	121	87	100	34	204	175
09/10 t-test	N.S		**		***		N.S	
09/10 median	340	383	109	59	71	15	85	54
09/10 Mann-Whitney	N.S		***		***		N.S	

Indicator results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

6.5 Purchased concentrate cost per UAA and per LU

Table 6-13 shows the results for 2009-10 giving the mean and median across all farms (including those cereals, horticultural and general cropping farms which have small amounts of livestock) and the split between organic and conventional farms. As for previous indicators, it can be seen that there are outliers with particularly high costs which skew the mean to be higher than the median. The minima are negative as, for some farms

(10 in total), fodder costs exceed feddingstuff costs purchased. This suggests that the fodder costs figure includes the cost of homegrown forage and so this indicator approximates the cost of purchased concentrates but may underestimate it. Appendix C2 shows the full data set for purchased concentrate costs per UAA and per LU. There is good agreement between the data for 2008-09 and 2009-10.

Table 6-13: Purchased concentrates cost 2009/10 across all farms and split into organic and conventional farms

	Purchased concentrates cost/ UAA (£/ha)		**Purchased concentrates cost/LU (£/LU)**	
average	4240.22		216.29	
Median	57.88		104.61	
	Conventional	**Organic**	**Conventional**	**Organic**
Average	4631.61	369.38	219.87	180.54
Median	60.45	40.54	108.54	63.24
Min	-9.52	-9.13	-23.26	-13.51
Max	3559626.67	23958.84	5303.35	2758.22
Stdev	88190.88	1817.38	414.29	299.22
Sample size	2253	190	1833	177

Considering individual robust farm types (Table 6-14 and Appendix C2), it can be seen that the highest costs per livestock unit occur for pig and poultry farms followed by dairy farms (ignoring cereals, general cropping and horticulture farms as they so not specialise in livestock). LFA and lowland grazing livestock farms have much lower costs of concentrates.

Table 6-14: Comparison of the purchased concentrate cost/LU (£/LU) for each robust farm type for 2009/10

Farm type	Pigs	Poultry	Dairy	LFA grazing livestock	Lowland grazing livestock	Mixed
Median Purchased concentrate cost per LU	594.78	592.73	319.10	84.45	84.26	76.06
Mean purchased concentrate cost per LU	528.32	1173.29	327.92	98.01	60.19	193.17

The statistical significance of these results is investigated in Tables 6-15 and 6-16. These show the mean and median purchased concentrate costs for conventional (left hand side) and organic (right hand side) farms and the results of the t-test and Mann-Whitney U test. It can be seen from these that, as is the case for purchased feed cost there is less of a significant difference between organic and conventional farms with regards to purchased concentrate costs. For dairy farms the purchased concentrate cost per livestock unit is slightly higher for organic than for conventional farms but this is generally not significant (or only significant at a low confidence level) and may reflect higher organic feed prices rather than greater use of purchased concentrates. For lowland grazing livestock there is a more strongly significant difference with organic farms having lower purchased concentrate costs (both per UAA and per livestock unit). This is also reflected in LFA grazing livestock farms although with slightly lower significance. In general the results for mixed farms are not significantly different between organic and conventional.

Table 6-15: Purchased concentrate cost /UAA (£/ha), significance of differences between organic and conventional farms

Farm type	Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample size	387	52	532	41	253	33	201	22
08/09 mean	690	560	104	71	163	36	378	281
08/09 t-test	*		*		N.S		N.S	
08/09 median	609	543	75	50	74	11	76	31
08/09 Mann-Whitney	N.S		***		***		N.S	
09/10 sample size	397	51	525	41	253	32	185	23
09/10 mean	666	521	104	61	173	25	286	478
09/10 t-test	*		**		N.S		N.S	
09/10 median	588	485	77	41	82	10	71	40
09/10 Mann-Whitney	**		***		***		N.S	

Indicator results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

Table 6-16: Purchased concentrate cost/LU (£/LU), significance of differences between organic and conventional farms

Farm type	Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample size	387	52	532	41	253	33	201	22
08/09 mean	335	400	100	88	92	38	209	96
08/09 t-test	*		N.S		***		***	
08/09 median	334	410	91	65	63	15	78	28
08/09 Mann-Whitney	*		*		***		*	
09/10 sample size	397	51	525	41	253	32	185	23
09/10 mean	323	363	100	76	92	28	196	170
09/10 t-test	N.S		*		***		N.S	
09/10 median	313	365	87	52	66	12	79	35
09/10 Mann-Whitney	N.S		***		***		N.S	

Indicator results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

6.6 Intensification indicator

The intensification indicator is based on the suggestion in the IRENA project (EEA, 2005) and consists of the sum of the purchased concentrate cost, fertiliser cost and crop protection cost divided by the UAA. This should separate out intensive, high input farms from more extensive production systems which are generally believed to have lower environmental impact (EEA, 2005). The organic intensification indicator has a negative minimum due to the negative minima in the purchased concentrates, discussed above in Section 2.4. The full data set for this indicator can be seen in Appendix D.

Again, there is good agreement between the data from 2008-09 and 2009-10 and an apparent difference between organic and conventional systems. Table 6-17 shows the mean and median values of the indicator across all farms (again highlighting that there are some farms with particularly high costs) and comparing organic with conventional.

Table 6-17: Intensification indicator 2009/10 across all farms and then split into organic and conventional farms.

	Intensification indicator (£/ha)	
average	4940.54	
Median	258.51	
	Conventional	**Organic**
Average	5380.62	576.59
Median	273.10	62.83
Min	0.00	-9.13
Max	3559626.67	24963.23
Stdev	88248.17	2670.43
Sample size	2253	190

Table 6-18 and Appendix D allow further scrutiny of individual farm types which suggests that pig and poultry farms are particularly intensive, followed by horticultural farms, whereas LFA and lowland grazing livestock farms are much less intensive production systems and therefore may have lower environmental impacts.

Table 6-18: Comparison of the intensification indicator (£/ha) for each robust farm type for 2009/10

Farm type	Cereals	General cropping	Horticultural	Pigs	Poultry	Dairy	LFA grazing livestock	Lowland grazing livestock	Mixed
Median intensification indicator	268.63	301.09	776.74	3886.09	8392.87	719.97	116.78	109.82	207.57
Mean intensification indicator	265.43	334.96	6754.91	26627.00	150929.13	794.55	144.75	209.29	442.8

The statistical significance of these results is investigated in Table 6-19. This shows the mean and median intensification indicator for conventional (left hand side) and organic (right hand side) farms and the results of the t-test and Mann-Whitney U test. It can be seen from these that, in general, there is a statistically significant difference in the intensification indicator between organic and conventional farms with conventional farms generally appearing to be more intensive than organic farms.

Table 6-19: Intensification indicator (£/ha), significance of differences between organic and conventional farms

Farm type	Cereals		General cropping		Horticulture		Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample	362	14	186	12	193	8	387	52	532	41	253	33	201	22
08/09 mean	229	22	309	68	7259	150	843	574	148	79	217	39	512	297
08/09 t-test	***		***		***		***		***		N.S		N.S	
08/09 median	227	10	261	49	886	32	760	543	115	60	134	16	216	80
08/09 Mann-Whitney	***		***		***		***		***		***		***	
09/10 sample	356	17	197	12	200	10	397	51	525	41	253	32	185	23
09/10 mean	279	18	344	265	6967	3783	828	529	153	68	235	32	436	497
09/10 t-test	***		N.S		N.S		***		***		N.S		N.S	
09/10 median	274	8	312	40	838	143	755	490	127	51	132	13	216	73
09/10 Mann-Whitney	***		***		**		***		***		***		***	

Results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

6.7 Agri-environmental scheme payments per UAA

Table 6-20 shows the mean and median agri-environmental scheme payments per UAA across all farms, showing that these are much more evenly distributed with no outliers (the mean and median are much more similar than for, say, fertiliser costs). It also shows the comparison between conventional and organic farms which reveals that organic farms appear to obtain a higher level of agri-environment scheme payments suggesting that they are more heavily involved in such schemes. Appendix E sets out the results for the agri-environmental scheme payments indicator. Again, this shows good agreement for 2008-09 and 2009-10, which would be expected as there have been no major changes in the English and Welsh agri-environmental schemes over this period.

Table 6-20: Agri-env scheme payments / UAA 2009/10 across all farms and split into organic and conventional farms

	Agri-env scheme payments / UAA (£/ha)	
average	38.48	
Median	28.25	
	Conventional	**Organic**
Average	31.61	102.43
Median	26.06	80.46
Min	0.00	0.00
Max	488.89	490.60
Stdev	46.43	79.49
Sample size	2253	190

Considering farms by robust type (Table 6-21 and Appendix E), it can be seen that horticultural farms have the lowest level of payments followed by pig and poultry farms. This would be expected as there is limited agri-environmental support for horticulture, including organic horticulture within the UK. Cereal farms, lowland grazing livestock and LFA grazing livestock farms have the highest levels of agri-environmental payments suggesting that these types of farms are most active in taking agri-environmental measures.

Table 6-21: Comparison of agri-environment scheme payments per UAA (£/ha) for each robust farm type for 2009/10.

Farm type	Cereals	General cropping	Horti-cultural	Pigs	Poultry	Dairy	LFA grazing livestock	Lowland grazing livestock	Mixed
Median ag-env scheme payments/UAA	30.21	29.83	0	0	0	23.26	31.63	30.00	30.22
Mean ag-env scheme payments per UAA	44.04	38.44	10.67	24.19	20.19	31.10	47.19	51.61	43.4

The statistical significance of these results is investigated in Table 6-22. This shows the mean and median results for conventional (left hand side) and organic (right hand side) farms and the results of the t-test and Mann-Whitney U test. It can be seen that, for all farms except horticulture, there is a statistically significant difference at the 0.5% level between organic and conventional farms, with organic farms receiving higher agri-environment payments than conventional. For horticultural farms the results are less significant and both organic and conventional farms appear to have low levels of payments under these schemes.

Table 6-22: Agri-environment scheme payments over UAA (£/ha), significance of differences between organic and conventional farms

Farm type	Cereals		General cropping		Horticulture		Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample	362	14	186	12	193	8	387	52	532	41	253	33	201	22
08/09 mean	37	144	33	87	10	47	23	77	35	109	36	118	35	124
08/09 t-test	***		***		N.S		***		***		***		***	
08/09 median	30	130	30	71	0	0	18	61	28	96	29	97	30	101
08/09 Mann-Whitney	***		***		*		***		***		***		***	
09/10 sample	356	17	197	12	200	10	397	51	525	41	253	32	185	23
09/10 mean	39	144	34	86	10	34	24	85	37	126	40	116	38	87
09/10 t-test	***		***		N.S		***		***		***		***	
09/10 median	30	119	29	76	0	0	20	61	30	93	29	90	30	70
09/10 Mann-Whitney	***		***		**		***		***		***		***	

Results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

6.8 Shannon crop diversity index

The Shannon crop diversity index is calculated as:

$H = -\sum p_i \ln(p_i)$

where p_i is the area fraction for an individual crop.

The larger the Shannon index value the more diversity within the cropping area. A farm with several small fields of different crops but a large proportion of one crop will have a lower Shannon diversity index than a farm with the same number of crops evenly divided across the farm. It has been postulated by some authors that greater cropping diversity is associated with greater biodiversity in general or with greater provision of ecosystem services and so has a positive environmental impact (Altieri, 1999; Hajjar *et al.*, 2008).

In this case the crop types that were used were: barley, beans, horticulture, oilseed rape, peas, permanent grass, potatoes, sugar beet and wheat. The denominator for these was taken as the sum of all of the cropping areas (barley, beans, oilseed rape, horticulture, peas, potatoes, permanent grass and sugar beet), if the farm had no land in any of these categories then it was excluded from the sample. This was due to the fact that UAA, area farmed and total farm area (which are the main areas provided in the calcdata section of the FBS) do not include multiple cropping but only the areas of main cropping whereas the individual product areas include both. As a result it was possible to have a crop area exceeding the total area resulting in an, incorrectly, negative Shannon index. Using the sum of the crop areas as a denominator prevents this from occurring.

It must be considered that a farm with a zero index (i.e. if the only crop, from those considered, that it grows is for example permanent grass), then that signifies that it only has one of the crops considered. It may be that a large diversity of other crops are grown on the farm but were not considered here. For instance, organic farms may grow oats, triticale and rye rather than wheat but these crops were not considered here as their cropping areas are not readily available from the FBS calcdata variables. Similarly, horticultural area may describe a large expanse of one crop or the growing of multiple crops. Also, permanent grass may include a large number of species of grass and also various herbs. This is not recorded in the FBS and so cannot be derived from it. This is one limitation of using FBS/FADN data to derive environmental indicators: the data are obtained for economic reasons and so may not contain all the information which would be desirable to measure environmental factors to best effect.

Appendix F shows the full data set for the Shannon crop diversity index. It can be seen from this that the 2008-09 data and the 2009-10 data give similar values.

Table 6-23: Shannon diversity index 2009/10 across all farms and then split into organic and conventional farms.

	Shannon diversity index	
average	0.3888	
Median	0.0000	
	Conventional	**Organic**
Average	0.3997	0.2619
Median	0.0000	0.0000
Min	0.0000	0.0000
Max	1.7557	1.5590
Stdev	0.5054	0.4138
Sample size	2209	188

Table 6-23 shows the mean and median values of the index across all farms in 2009-10 and the comparison of organic and conventional. It can be seen that there is a difference between the mean and median suggesting the presence of outliers with higher diversity. It can also be seen that organic farms appear to have a lower diversity (across the crops considered) than conventional farms.

Appendix F shows the median and mean Shannon diversity index for each robust farm type and splits them into conventional and organic farms where there is sufficient data to do so and Table 6-24 summarises some of the data for 2009-10. The highest values, and greatest cropping diversity, occur on general cropping farms, followed by cereals farms and mixed farms. The lowest cropping diversity, as might be expected occurs on LFA grazing livestock farms (which would be expected to mainly consist of permanent grassland).

Table 6-24: Comparison of the Shannon crop diversity index for each robust farm type for 2009/10.

Farm type	Cereals	General cropping	Horti-cultural	Pigs	Poultry	Dairy	LFA grazing livestock	Lowland grazing livestock	Mixed
Median Shannon crop diversity index	1.05	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.73
Mean Shannon crop diversity index	0.99	1.13	0.11	0.27	0.11	0.19	0.03	0.12	0.75

The statistical significance of these results is investigated in Table 6-25. This shows the mean and median Shannon crop diversity indices for conventional (left hand side) and organic (right hand side) farms and the results of the t-test and Mann-Whitney U test. It can be seen from these that for the majority of the farm types there is no significant difference between organic and conventional farms. For mixed farms and lowland grazing livestock farms there is a significant difference with organic farms having a lower index suggesting that they show lower diversity in the crops considered here than do conventional farms.

Table 6-25: Shannon crop diversity indicator, significance of differences between organic and conventional farms

Farm type	Cereals		General cropping		Horticulture		Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample	362	14	185	12	194	8	381	50	529	41	251	33	201	22
08/09 mean	0.99	0.94	1.12	1.02	0.13	0.17	0.19	0.15	0.03	0.02	0.16	0.05	0.80	0.51
08/09 t-test	N.S		N.S		N.S		N.S		N.S		***		***	
08/09 median	1.03	0.97	1.20	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.62
08/09 Mann-Whitney	N.S		N.S		N.S		N.S		N.S		*		***	
09/10 sample	356	16	196	12	201	10	387	50	524	41	251	32	185	23
09/10 mean	1.0	0.81	1.14	1.04	0.10	0.13	0.18	0.15	0.03	0.05	0.14	0.01	0.78	0.51
09/10 t-test	*		N.S		N.S		N.S		N.S		***		***	
09/10 median	1.05	0.69	1.19	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.58
09/10 Mann-Whitney	N.S		N.S		N.S		N.S		*		***		***	

Results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

6.9 Livestock units per forage grazing area

This indicator highlights which farms are the most intensive (and likely to be reliant on bought-in-feed) and conversely which keep small amounts of livestock compared to the amount of grazing available. This gives an idea of the amount of pressure on the grazing land and the reliance of the farm on external inputs. Appendix G shows the full results for the indicator livestock units per ha forage grazing. Again, there is good agreement between 2008-09 and 2009-10 data.

It can be seen from Table 6-26 that similarly to the other intensity indicators such as purchased feed (which may be related as discussed above), fertiliser cost and pesticide cost, there are outliers which increase the mean compared with the median (in this case these are farms with large amounts of livestock compared with their land area). It can also be seen that organic farms appear in general to have a lower number of livestock units per ha forage area compared with conventional farms.

Table 6-26: Livestock unit per forage grazing 2009/10 across all farms and split into organic and conventional farms.

	Livestock units per forage grazing (LU/ha)	
average	14.19	
Median	1.11	
	Conventional	**Organic**
Average	15.52	1.58
Median	1.15	1.00
Min	0.00	0.00
Max	9171.33	58.17
Stdev	281.83	4.85
Sample size	2111	185

Considering the indicator across farm types in Table 6-27 (and ignoring cereals, horticultural and general cropping farms, some of which have small amounts of livestock) and Appendix G, it can be seen that poultry and pig farms have the highest number of livestock per ha forage grazing whereas LFA grazing livestock farms have the lowest followed by lowland grazing farms and then dairy farms. This suggests that poultry and pig farms are more intensive (agreeing with the results for the intensification indicator calculated earlier) and LFA grazing livestock farms are much less intensive and therefore may have a lower environmental impact.

Table 6-27: Comparison of LUs per forage grazing (LU/ha) for each robust farm type for 2009/10.

Farm type	Pigs	Poultry	Dairy	LFA grazing livestock	Lowland grazing livestock	Mixed
Median LU per forage grazing	16.07	15.03	1.96	0.93	1.21	1.32
Mean LU per forage grazing	176.63	203.16	2.07	1.00	1.49	55.16

The statistical significance of these results is investigated in Table 6-28. This shows the mean and median livestock units per forage grazing for conventional (left hand side) and organic (right hand side) farms and the results of the t-test and Mann-Whitney U test. It can be seen from these that dairy farms and lowland grazing livestock farms show significant differences between organic and conventional management with organic farms having lower stocking densities. The difference for LFA farms is still significant but only at the 5% level. This might be expected as LFA grazing farms may have low stocking rates regardless of management system due to their nature and the fact these areas are unlikely to be able to support high densities of livestock.

Table 6-28: Livestock units per forage area (LU/ha), significance of differences between organic and conventional farms

Farm type	Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample size	387	52	532	41	253	33	198	22
08/09 mean	2.13	1.50	1.02	0.80	1.50	1.00	4.32	3.81
08/09 t-test	***		*		*		N.S	
08/09 median	2.06	1.45	0.96	0.82	1.31	0.89	1.48	1.11
08/09 Mann-Whitney	***		*		***		N.S	
09/10 sample size	397	51	525	41	253	32	182	23
09/10 mean	2.15	1.48	1.02	0.82	1.57	0.92	61.63	3.90
09/10 t-test	***		***		*		N.S	
09/10 median	2.07	1.40	0.95	0.83	1.32	0.83	1.39	1.01
09/10 Mann-Whitney	***		*		***		*	

Results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

Alternatively, it is also possible to consider only grazing livestock units (e.g excluding pigs and poultry). Table 6-29 shows summary results for 2009-10 across all farms and split into organic and conventional and the full results are shown in Appendix G2. It can be seen from this that the exclusion of pigs and poultry greatly reduces the averages (particularly for conventional farms) and brings the mean and median much close together, suggesting that the majority of the outliers were due to pigs or poultry on the farms. The same pattern as previously can be seen in the remaining (grazing livestock) farm types with LFA grazing livestock farms having the lowest stocking density, followed by lowland grazing farms and then dairy farms (Table 6-30 and Appendix G2).

Table 6-29: Grazing livestock units per forage grazing 2009/10 across all farms and then split into organic and conventional farms.

	Grazing livestock unit per forage grazing (grazing LU/ha)	
average	1.18	
Median	0.99	
	Conventional	**Organic**
Average	1.20	0.97
Median	1.02	0.97
Min	0.00	0.00
Max	33.49	3.32
Stdev	1.69	0.55
Sample size	2111	185

Table 6-30: Comparison of grazing LUs per forage grazing (grazing LU/ha) for dairy, lowland and LFA grazing livestock farm types for 2009/10.

Farm type	Dairy	LFA grazing livestock	Lowland grazing livestock
Median grazing LU per forage grazing	1.95	0.92	0.20
Mean grazing LU per forage grazing	2.05	1.00	1.48

The statistical significance of these results is investigated in Table 6-31. This shows the mean and median grazing livestock units per forage area for conventional (left hand side) and organic (right hand side) farms and the results of the t-test and Mann-Whitney U test. It can be seen from these that there is a significant difference for almost all farm types (and particularly strongly for dairy and lowland grazing livestock types) between organic and conventional farms with organic farms tending to have lower stocking densities.

Table 6-31: Grazing livestock units per forage area (grazing LU/ha), significance of differences between organic and conventional farms

Farm type	Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample size	387	52	532	41	253	33	198	22
08/09 mean	2.11	1.49	1.02	0.78	1.49	1.00	1.51	1.04
08/09 t-test	***		***		*		N.S	
08/09 median	2.06	1.45	0.96	0.82	1.30	0.89	0.26	1.00
08/09 Mann-Whitney	***		**		***		N.S	
09/10 sample size	397	51	525	41	253	32	182	23
09/10 mean	2.13	1.47	1.02	0.81	1.56	0.92	1.60	0.91
09/10 t-test	***		***		*		N.S	
09/10 median	2.06	1.39	0.95	0.77	1.30	0.83	1.24	0.91
09/10 Mann-Whitney	***		*		***		***	

Results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

6.10 The proportion of the land that is woodland, permanent grass, or fallow

The full data set for the indicator, proportion of land (UAA + woodland area + net land hired in) that is woodland, permanent grass or fallow is shown in Appendix H and again shows good agreement between years, 2008-09 and 2009-10. As for the agri-environmental scheme payment indicator the mean and median are relatively similar suggesting that there are very few outliers. This indicator should reveal those farm types or systems which provide a greater number of potential habitats within the farm.

Table 6-32 shows the mean and median across all farm types and a comparison of organic and conventional farms. It can be seen that organic farms appear to have a slightly higher proportion of permanent grassland, woodland, and fallow.

Table 6-32: Proportion of UAA that is woodland, permanent/temporary grass or forage/fallow 2009/10 across all farms and then split into organic and conventional farms.

	Proportion of land that is woodland, permanent grass or fallow	
average	0.5136	
Median	0.5254	
	Conventional	**Organic**
Average	0.5083	0.5839
Median	0.5086	0.6072
Min	0.0000	0.0000
Max	1.0000	1.0000
Stdev	0.3843	0.3416
Sample size	2251	190

Considering the robust farm types individually (see Table 6-33 and Appendix H), cereals, horticulture and general cropping farms have a lower proportion of UAA that is woodland, grass, forage or fallow whereas livestock-related farms have higher proportions. This suggests that livestock farms may provide a greater amount of habitat for wildlife species than arable farms.

Table 6-33: Comparison of proportion of land that is woodland, permanent grass or fallow for each farm type for 2009/10.

Farm type	Cereals	General cropping	Horti-cultural	Pigs	Poultry	Dairy	LFA grazing livestock	Lowland grazing livestock	Mixed
Median proportion of land	0.0999	0.0476	0.0000	0.6739	1.0	0.7003	0.8859	0.8805	0.4700
Mean proportion of land	0.1479	0.1379	0.1478	0.5349	0.7132	0.6424	0.7682	0.7871	0.4514

The statistical significance of these results is investigated in Table 6-34. This shows the mean and median proportions for conventional (left hand side) and organic (right hand side) farms and the results of the t-test and Mann-Whitney U test. It can be seen from these that for the majority of farm types there is no statistically significant difference between organic and conventional. Only for general cropping farms is there a significant difference with organic farms having a higher proportion of land that is woodland, fallow or permanent grassland.

Table 6-34: Proportion of land that is woodland, permanent grass or fallow, significance of differences between organic and conventional farms

Farm type	Cereals		General cropping		Horticulture		Dairy		LFA grazing livestock		Lowland grazing livestock		Mixed	
	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF	CF	OF
08/09 sample	362	14	186	12	193	8	387	52	532	41	253	33	201	22
08/09 mean	0.15	0.26	0.12	0.32	0.15	0.32	0.67	0.61	0.76	0.72	0.80	0.80	0.43	0.59
08/09 t-test	N.S		*		N.S		N.S		N.S		N.S		**	
08/09 median	0.10	0.16	0.05	0.29	0.00	0.02	0.75	0.66	0.89	0.87	0.90	0.90	0.40	0.64
08/09 Mann-Whitney	*		***		N.S		N.S		N.S		N.S		**	
09/10 sample	356	17	197	12	200	10	397	51	525	41	253	32	185	23
09/10 mean	0.14	0.21	0.12	0.34	0.14	0.33	0.65	0.57	0.77	0.71	0.78	0.83	0.45	0.50
09/10 t-test	N.S		***		N.S		N.S		N.S		N.S		N.S	
09/10 median	0.10	0.17	0.04	0.37	0.00	0.02	0.71	0.60	0.89	0.86	0.88	0.92	0.45	0.54
09/10 Mann-Whitney	N.S		***		N.S		N.S		N.S		N.S		N.S	

Results showing whether there are significant differences between organic and conventional farms for each farm type for t-test and for Mann Whitney U test.

6.11 Conclusions

A selection of indicators was used to compare organic and conventional farms across robust farm types using FBS data. The indicators assessed were:

- Fertiliser cost
- Crop protection cost
- Purchased feed cost
- Intensification indicator
- Monetary receipts from agri-environmental schemes
- Shannon crop diversity index
- Average number of livestock units per ha of forage area
- Proportion of land that is permanent grass, woodland, or fallow.

These assess the level of inputs (fertiliser, crop protection, purchased feed), intensity of the agriculture (intensification indicator, LUs per forage area), participation in agri-environmental activities (monetary receipts from agri-environmental schemes), diversity of cropping (Shannon index), and availability of wildlife habitats (proportion of land that is permanent grassland, woodland, or fallow).

These indicators assume that cost is a good proxy for usage. This appears likely to be the case for fertiliser and crop protection but is perhaps less likely to be the case for purchased feed where prices are likely to be very variable between different feedstuffs and between organic and conventional feed. It is also only suitable for comparison of farms within a year. If comparisons were taking place over time, e.g. to track changes in environmental performance over time, then standard costs need to be used to derive physical quantities from cost otherwise inflation and other price fluctuations will affect the results. Alternatively price indices, which may be more easily obtained, could be used to remove inflationary effects from the expenditure and so allow a comparison of costs from year to year.

As discussed in Section 6.8, the Shannon crop diversity index is calculated using the crop fractions of a selection of crops and the denominator was taken as the total of these. It must, therefore, be considered that a farm with a zero index (i.e. if the only crop, from those considered, that it grows is for example permanent grass) signifies that it only has one of the crops considered. It may be that a large diversity of other crops is grown on the farm but were not considered here.

Also, permanent grass may include a large number of species of grass and various herbs. This is not recorded in the FBS and so cannot be derived from it. This highlights one important limitation of using FBS/FADN data to derive environmental indicators: the data are obtained for economic reasons and so may not contain all the information which would be desirable to measure environmental factors to best effect.

Each indicator was assessed across all farms within the survey (excluding those that gave rise to divide by zero errors) and across all organic and all conventional farms. The indicators were then calculated for each farm type and the split of these into organic and conventional.

Some of the indicators have means which are larger than their medians (fertiliser cost, crop protection cost, intensification indicator, LU per forage area). This suggests that the distributions may have outliers with particularly high costs or stocking densities. Since means are more sensitive to outliers than the median value this skews them towards a much higher value.

With regards to farm types it appears that horticultural farms use large amounts of fertiliser and crop protection which makes them a more intensive type of farm (after pig and poultry farms). They also tend to have lower levels of agri-environment scheme participation. Poultry and pig farms are particularly intensive, mainly due to the high levels of purchased feed per livestock unit and their high stocking densities. They also show low levels of agri-environment scheme participation however they have a relatively high proportion of their land (medians of more than 60%) that is woodland, grass, forage or fallow which suggests that they may provide a greater amount of habitat for wildlife species. However, pig and poultry farms generally have a small land area therefore dairy and grazing livestock farms which also have a relatively high proportion of their land that is woodland, permanent grass or fallow are likely to provide a much greater area of wildlife habitats as they have a much larger farm size.

Grazing livestock farms would appear, in fact, to perform quite well across the majority of the indicators. They are generally low intensity farms with low purchased feed, fertiliser and crop protection costs and low stocking densities. They also have higher levels of agri-environment scheme participation as shown by the higher payments received from such schemes. Only for the Shannon diversity index do they show a less positive result with low levels of diversity due to the fact that, by their nature, they tend to be almost entirely grassland farms.

The results of the Mann-Whitney test comparing organic and conventional farms showed that there are statistically significant differences between organic and conventional farms in terms of fertiliser cost, crop protection cost, intensification, and agri-environment scheme payments. These results suggest that organic farms are less intensive with lower fertiliser and crop protection use and tend to be involved in more agri-environment schemes than conventional farms. In contrast there is no significant difference between organic and conventional farms with regards to crop diversity except for mixed and lowland grazing livestock farms where organic farms have a statistically significantly lower diversity. There is also no significant difference between organic and conventional farms in terms of the proportion of land that is woodland, permanent grass or fallow except for general cropping farms where organic farms generally have a higher proportion.

With regards to purchased feed costs and livestock stocking densities, whether there is a significant difference between organic and conventional farms depends on the robust farm type. Purchased feed and purchased concentrate costs for dairy farms only show differences of low statistical significance with organic farms having slightly higher costs per livestock unit (possibly due to higher organic feed prices rather than higher usage). For lowland grazing livestock there is a more strongly significant difference with organic farms having lower purchased feed costs. This is also reflected in LFA grazing livestock farms although with a slightly lower significance. In general purchased feed or concentrate costs are not significantly different between conventional and organic mixed farms. Dairy and lowland grazing livestock farms show significant differences in stocking density between organic and conventional management with organic farms tending to have lower stocking densities. The difference for LFA grazing livestock farms is only significant at the 5% level, perhaps reflecting the fact that such farms tend to be unable to support larger stocking densities regardless of management system.

In general it appears from the analysis that organic farms are less intensive than conventional farms, however organic farms appear to have less cropping (and potentially less habitat) variety as reflected by some of the Shannon index results. It would also appear that grazing livestock farms in general may be beneficial to the environment as assessed using this particular set of indicators.

It appears from the analysis presented here that it is possible to use economic data such as the FBS to provide some information on the environmental performance of farms and to compare this across different types if farms and farming systems. In particular it would be of great interest to combine some of the indicators into an overall score that took account of intensity, crop variation, variation in habitat and stocking rates, as well as agri-environment payments. Although an indirect measure of environmental performance may never achieve a perfect assessment a combined score could be weighted to reflect the relative importance of the various factors.

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Appendices

Appendix A - Fertilisers

	Fertiliser cost/UAA		**Fertiliser cost/output**	
average	564.68		0.0677	
median	68.18		0.0594	
	Conventional	Organic	Conventional	Organic
Conv/org average	608.00	9.74	0.0729	0.0112
Conv /org median	75.72	0.00	0.0647	0.0000
Conv/org min	0.00	0.00	-2.6906	0.0000
Conv/org max	101995.77	121.18	2.0184	0.1401
Con/org stdev	4080.75	19.28	0.0927	0.0219
Conv/org sample	2237	188	2260	188

Fertiliser cost 2008/09 across all farms and then split into organic and conventional farms.

	Fertiliser cost/UAA		**Fertiliser cost/output**	
average	574.65		0.0856	
median	80.41		0.0645	
	Conventional	Organic	Conventional	Organic
Conv/org average	615.52	179.28	0.0924	0.0128
Conv /org median	92.13	0.00	0.0712	0.0000
Conv/org min	0.00	0.00	-0.0503	0.0000
Conv/org max	77860.00	20581.21	0.6182	0.1451
Conv/org stdev	3685.09	1704.53	0.0839	0.0263
Conv/org sample	2253	190	2275	190

Fertiliser cost 2009/10 across all farms and then split into organic and conventional farms.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 cereals mean	102.66	106.64	9.89	0.1199	0.1240	0.0185
2008/09 cereals median	101.88	104.56	2.97	0.1134	0.1155	0.0040
2009/10 cereals mean	150.79	158.51	10.85	0.1921	0.2013	0.0215
2009/10 cereals median	149.44	155.73	0.00	0.1927	0.1982	0.0000

Fertiliser costs for cereals farms for 2008/09 and 2009/10.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 General cropping mean	119.11	127.08	12.40	0.0840	0.0911	0.0064
2008/09 General cropping median	106.44	110.25	1.84	0.0786	0.0825	0.0028
2009/10 General cropping mean	164.84	175.31	19.22	0.1320	0.1411	0.0151
2009/10 General cropping median	154.81	157.73	8.67	0.1262	0.1320	0.0033

Fertiliser costs for general cropping farms for 2008/09 and 2009/10.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Horticulture mean	5997.70	6187.28	10.02	0.0390	0.0403	0.0029
2008/09 Horticulture median	306.12	347.93	0.00	0.0268	0.0274	0.0000
2009/10 Horticulture mean	5702.76	5897.34	3246.24	0.0355	0.0363	0.0243
2009/10 Horticulture median	311.73	364.68	20.55	0.0256	0.0267	0.0046

Fertiliser costs for horticulture farms for 2008/09 and 2009/10.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Pigs mean	21.22	21.22	none	0.0036	0.0036	none
2008/09 Pigs median	0.00	0.00	none	0.0000	0.0000	none
2009/10 Pigs mean	37.09	37.09	none	0.0104	0.0104	none
2009/10 Pigs median	0.00	0.00	none	0.0000	0.0000	none

Fertiliser costs for pig farms for 2008/09 and 2009/10.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Poultry mean	5.99	4.66	17.59	0.0013	0.0014	0.0054
2008/09 Poultry median	0.00	0.00	0.00	0.0013	0.0000	0.0000
2009/10 Poultry mean	10.10	11.07	Insuff. Sample	0.0022	0.0024	Insuff. sample
2009/10 Poultry median	0.00	0.00	Insuff. sample	0.0000	0.0000	Insuff. sample

Fertiliser costs for poultry farms for 2008/09 and 2009/10.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Dairy mean	120.57	135.29	12.94	0.0472	0.0532	0.0049
2008/09 Dairy median	111.62	121.57	0.00	0.0445	0.0481	0.0000
2009/10 Dairy mean	129.39	144.78	8.12	0.0543	0.0608	0.0036
2009/10 Dairy median	123.93	135.99	0.00	0.0502	0.0543	0.0000

Fertiliser costs for dairy farms for 2008/09 and 2009/10.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 LFA grazing livestock mean	38.63	41.78	7.97	0.0743	0.0789	0.0203
2008/09 LFA grazing livestock median	28.27	32.31	0.00	0.0750	0.0812	0.0000
2009/10 LFA grazing livestock mean	43.36	47.21	7.15	0.0775	0.0834	0.0202
2009/10 LFA grazing livestock median	32.34	38.52	0.56	0.0684	0.0764	0.0006

Fertiliser costs for LFA grazing livestock for 2008/09 and 2009/10.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	39.87	45.87	2.69	0.0512	0.0584	0.0061
2008/09 Lowland grazing livestock median	21.03	31.39	0.00	0.0346	0.0457	0.0000
2009/10 Lowland grazing livestock mean	46.80	52.78	5.86	0.0532	0.0598	0.0076
2009/10 Lowland grazing livestock median	27.58	32.48	0.00	0.0373	0.0458	0.0000

Fertiliser costs for lowland grazing livestock 2008/09 and 2009/10.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Mixed mean	72.88	80.00	12.23	0.0685	0.0742	0.0196
2008/09 Mixed median	70.10	74.04	1.81	0.0623	0.0671	0.0018
2009/10 Mixed mean	86.74	95.95	12.65	0.0880	0.0969	0.0165
2009/10 Mixed median	86.56	92.82	0.00	0.0716	0.0761	0.0000

Fertiliser costs for mixed farms for 2008/09 and 2009/10.

	Fertiliser cost/ UAA			Fertiliser cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Other mean	7.47	7.47	none	0.1020	0.1020	none
2008/09 Other median	0.00	0.00	none	0.0000	0.0000	none
2009/10 Other mean	11.23	11.23	none	0.0500	0.0500	none
2009/10 Other median	0.00	0.00	none	0.0000	0.0000	none

Fertiliser costs for “other” farms 2008/09 and 2009/10.

Appendix B - Crop protection

	Crop protection cost/UAA		**Crop protection cost/output**	
average	122.86		0.0346	
median	10.36		0.0069	
	Conventional	Organic	Conventional	Organic
Conv/org average	131.35	3.77	0.0377	0.0017
Conv /org median	15.08	0.00	0.0090	0.0000
Conv/org min	0.00	0.00	-0.4024	0.0000
Conv/org max	11110.17	363.78	0.3752	0.0654
Con/org stdev	580.76	27.86	0.0546	0.0070
Conv/org sample	2237	188	2260	188

Crop protection cost 2008/09 across all farms and then split into organic and conventional farms.

	Crop protection cost/UAA		**Crop protection cost/output**	
average	125.66		0.0368	
median	10.52		0.0067	
	Conventional	Organic	Conventional	Organic
Conv/org average	133.49	27.93	0.0400	0.0019
Conv /org median	15.19	0.00	0.0083	0.0000
Conv/org min	0.00	0.00	0.0000	0.0000
Conv/org max	12435.59	4382.02	0.4105	0.0642
Conv/org stdev	571.41	318.94	0.0587	0.0071
Conv/org sample	2253	190	2275	190

Crop protection cost 2009/10 across all farms and then split into organic and conventional farms.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 cereals mean	102.72	106.92	3.67	0.1187	0.1231	0.0055
2008/09 cereals median	103.29	107.23	0.00	0.1131	0.1146	0.0000
2009/10 cereals mean	101.99	107.27	2.16	0.1291	0.1354	0.0039
2009/10 cereals median	103.02	105.14	0.00	0.1257	0.1276	0.0000

Crop protection costs for cereals farms for 2008/09 and 2009/10.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 General cropping mean	134.17	144.77	13.68	0.0908	0.0989	0.0067
2008/09 General cropping median	113.14	124.17	3.46	0.0886	0.0928	0.0025
2009/10 General cropping mean	128.41	137.75	12.98	0.0971	0.1048	0.0067
2009/10 General cropping median	114.38	119.90	8.97	0.0939	0.1021	0.0056

Crop protection costs for general cropping farms for 2008/09 and 2009/10.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Horticulture mean	1046.52	1063.89	45.53	0.0270	0.0283	0.0028
2008/09 Horticulture median	374.06	412.76	0.00	0.0123	0.0128	0.0000
2009/10 Horticulture mean	1043.08	1062.25	490.76	0.0272	0.0285	0.0052
2009/10 Horticulture median	405.96	429.65	0.00	0.0122	0.0127	0.0000

Crop protection costs for horticulture farms for 2008/09 and 2009/10.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Pigs mean	31.46	31.46	none	0.0058	0.0058	none
2008/09 Pigs median	0.00	0.00	none	0.0000	0.0000	none
2009/10 Pigs mean	37.96	37.96	none	0.0086	0.0086	none
2009/10 Pigs median	0.00	0.00	none	0.0000	0.0000	none

Crop protection costs for pig farms for 2008/09 and 2009/10.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Poultry mean	7.13	7.72	3.59	0.0017	0.0018	0.0007
2008/09 Poultry median	0.00	0.00	0.00	0.0000	0.0000	0.0000
2009/10 Poultry mean	9.77	10.71	Insuff. sample	0.0019	0.0020	Insuff. sample
2009/10 Poultry median	0.00	0.00	Insuff. sample	0.0000	0.0000	Insuff. sample

Crop protection costs for poultry farms for 2008/09 and 2009/10.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Dairy mean	15.77	17.88	0.21	0.0064	0.0072	0.0001
2008/09 Dairy median	8.71	10.79	0.00	0.0031	0.0041	0.0000
2009/10 Dairy mean	15.66	17.60	0.24	0.0067	0.0075	0.0001
2009/10 Dairy median	7.40	11.32	0.00	0.0036	0.0043	0.0000

Crop protection costs for dairy farms for 2008/09 and 2009/10.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 LFA grazing livestock mean	1.90	2.10	0.02	0.0041	0.0045	0.0001
2008/09 LFA grazing livestock median	0.30	0.50	0.00	0.0008	0.0016	0.0000
2009/10 LFA grazing livestock mean	1.96	2.17	0.05	0.0034	0.0037	0.0002
2009/10 LFA grazing livestock median	0.43	0.64	0.00	0.0011	0.0015	0.0000

Crop protection costs for LFA grazing livestock for 2008/09 and 2009/10.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	6.99	8.03	0.45	0.0083	0.0095	0.0010
2008/09 Lowland grazing livestock median	1.98	2.84	0.00	0.0036	0.0050	0.0000
2009/10 Lowland grazing livestock mean	7.71	8.66	1.33	0.0076	0.0084	0.0021
2009/10 Lowland grazing livestock median	1.67	3.15	0.00	0.0026	0.0041	0.0000

Crop protection costs for lowland grazing livestock 2008/09 and 2009/10.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Mixed mean	48.93	54.36	3.66	0.0390	0.0432	0.0042
2008/09 Mixed median	40.03	46.29	0.00	0.0382	0.0420	0.0000
2009/10 Mixed mean	48.99	54.27	6.49	0.0413	0.0460	0.0037
2009/10 Mixed median	35.50	41.97	0.00	0.0394	0.0442	0.0000

Crop protection costs for mixed farms for 2008/09 and 2009/10.

	Crop protection cost/ UAA			Crop protection cost/output		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Other mean	1.05	1.05	none	0.0056	0.0056	none
2008/09 Other median	0.00	0.00	none	0.0000	0.0000	none
2009/10 Other mean	0.51	0.51	none	0.0037	0.0037	none
2009/10 Other median	0.00	0.00	none	0.0000	0.0000	none

Crop protection costs for “other” farms 2008/09 and 2009/10.

Appendix C - Purchased feed

	Purchased feed cost/ UAA		Purchased feed cost/LU	
average	4570.46		239.07	
median	64.24		118.10	
	Conventional	Organic	Conventional	Organic
Conv/org average	5008.25	567.46	235.84	227.02
Conv /org median	67.00	62.95	121.58	77.97
Conv/org min	0	0	0	0
Conv/org max	3601700	38440.56	6245.39	5538.75
Con/org stdev	98077.38	3258.48	437.36	467.57
Conv/org sample	2237	188	1814	180

Purchased feed cost 2008/09 across all farms and then split into organic and conventional farms.

	Purchased feed cost/ UAA		Purchased feed cost/LU	
average	4253.18		227.60	
median	66.46		119.12	
	Conventional	Organic	Conventional	Organic
Conv/org average	4644.88	380.36	231.36	191.01
Conv /org median	69.53	46.98	123.35	73.14
Conv/org min	0	0	0	0
Conv/org max	3559626.67	23958.84	5303.35	2758.22
Conv/org stdev	88190.29	1818.70	413.73	302.46
Conv/org sample	2253	190	1833	177

Purchased feed cost 2009/10 across all farms and then split into organic and conventional farms.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 cereals mean	17.63	18.12	10.09	142.81	150.15	38.08
2008/09 cereals median	0	0	1.20	53.34	62.82	8.23
2009/10 cereals mean	13.74	14.10	8.38	121.33	127.69	32.56
2009/10 cereals median	0	0	1.50	54.18	57.10	18.02

Purchased feed costs for cereals farms for 2008/09 and 2009/10.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 General cropping mean	44.93	39.26	44.20	271.66	132.70	269.11
2008/09 General cropping median	0	0	45.53	58.24	57.50	54.09
2009/10 General cropping mean	43.19	32.31	236.16	168.80	128.20	317.58
2009/10 General cropping median	0	0	12.63	57.79	58.30	29.07

Purchased feed costs for general cropping farms for 2008/09 and 2009/10.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Horticulture mean	11.35	8.03	97.02	568.65	617.81	339.25
2008/09 Horticulture median	0	0	0	103.01	74.92	447.86
2009/10 Horticulture mean	9.60	7.93	45.91	410.35	442.75	237.53
2009/10 Horticulture median	0	0	0	45.07	42.54	277.41

Purchased feed costs for horticulture farms for 2008/09 and 2009/10.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Pigs mean	70075.38	70075.38	none	531.82	531.82	none
2008/09 Pigs median	6619.36	6619.36	none	596.68	596.68	none
2009/10 Pigs mean	26555.77	26555.77	none	528.67	528.67	none
2009/10 Pigs median	3884.51	3884.51	none	594.78	594.78	none

Purchased feed costs for pig farms for 2008/09 and 2009/10.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Poultry mean	136306.05	154661.79	10689.31	1214.38	1218.88	1141.56
2008/09 Poultry median	5531.11	5947.95	1410.42	549.81	550.24	296.29
2009/10 Poultry mean	150909.60	164764.27	Insuff. data	1173.39	1228.08	Insuff. Data
2009/10 Poultry median	8392.87	8719.85	Insuff. data	592.73	592.47	Insuff. data

Purchased feed costs for poultry farms for 2008/09 and 2009/10.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Dairy mean	709.99	727.78	579.48	361.46	354.19	414.14
2008/09 Dairy median	632.17	650.60	545.51	350.68	343.71	424.66
2009/10 Dairy mean	685.29	702.97	548.55	345.64	341.11	380.40
2009/10 Dairy median	620.49	632.72	511.06	341.96	340.22	383.27

Purchased feed costs for dairy farms for 2008/09 and 2009/10.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 LFA grazing livestock mean	115.08	120.14	77.27	114.26	117.34	97.39
2008/09 LFA grazing livestock median	83.69	87.97	55.81	100.92	103.60	76.49
2009/10 LFA grazing livestock mean	117.74	123.49	67.90	117.42	121.05	87.10
2009/10 LFA grazing livestock median	86.49	91.37	44.29	103.25	109.30	59.27

Purchased feed costs for LFA grazing livestock for 2008/09 and 2009/10.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	159.10	178.99	40.38	92.48	101.20	42.27
2008/09 Lowland grazing livestock median	72.16	84.04	19.84	62.57	73.21	21.06
2009/10 Lowland grazing livestock mean	168.12	187.68	29.98	92.60	100.58	34.31
2009/10 Lowland grazing livestock median	77.03	89.85	11.37	67.34	70.99	15.47

Purchased feed costs for lowland grazing livestock 2008/09 and 2009/10.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Mixed mean	375.34	386.45	293.86	206.65	217.51	110.22
2008/09 Mixed median	77.25	84.85	33.80	88.05	90.82	31.43
2009/10 Mixed mean	314.91	293.98	483.27	200.72	203.92	175.02
2009/10 Mixed median	77.41	293.98	44.25	80.22	85.41	53.82

Purchased feed costs for mixed farms for 2008/09 and 2009/10.

	Purchased feed cost/ UAA			Purchased feed cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Other mean	78.77	78.77	none	41.14	41.14	none
2008/09 Other median	0	0	none	0	0	none
2009/10 Other mean	129.42	129.42	none	64.66	64.66	none
2009/10 Other median	8.67	8.67	none	7.96	7.96	none

Purchased feed costs for “other” farms 2008/09 and 2009/10.

Appendix C2 - Purchased concentrates

	Purchased concentrate cost/ UAA		**Purchased concentrates cost/LU**	
average	4558.82		227.96	
median	55.84		104.34	
	Conventional	Organic	Conventional	Organic
Conv/org average	4996.22	558.02	224.41	217.41
Conv /org median	57.10	56.05	108.86	69.48
Conv/org min	-6.28	-6.38	-12.71	-8.92
Conv/org max	3601700.00	38440.56	6245.39	5538.75
Con/org stdev	98077.89	3258.81	436.86	466.90
Conv/org sample	2237	188	1814	180

Purchased concentrates cost 2008/09 across all farms and then split into organic and conventional farms.

	Purchased concentrates cost/ UAA		**Purchased concentrates cost/LU**	
average	4240.22		216.29	
median	57.88		104.61	
	Conventional	Organic	Conventional	Organic
Conv/org average	4631.61	369.38	219.87	180.54
Conv /org median	60.45	40.54	108.54	63.24
Conv/org min	-9.52	-9.13	-23.26	-13.51
Conv/org max	3559626.67	23958.84	5303.35	2758.22
Conv/org stdev	88190.88	1817.38	414.29	299.22
Conv/org sample	2253	190	1833	177

Purchased concentrates cost 2009/10 across all farms and then split into organic and conventional farms.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 cereals mean	15.66	16.12	8.41	135.21	142.33	32.94
2008/09 cereals median	0.00	0.00	0.96	47.39	53.73	4.54
2009/10 cereals mean	12.65	13.14	4.68	115.94	122.68	21.74
2009/10 cereals median	0.00	0.00	0.93	51.14	51.99	4.24

Purchased concentrates costs for cereals farms for 2008/09 and 2009/10.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 General cropping mean	42.97	37.20	42.29	264.56	124.56	266.40
2008/09 General cropping median	0.00	0.00	42.77	45.09	42.90	45.94
2009/10 General cropping mean	41.70	30.90	232.51	163.69	122.86	312.68
2009/10 General cropping median	0.00	0.00	8.33	39.73	49.21	26.35

Purchased concentrates costs for general cropping farms for 2008/09 and 2009/10.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Horticulture mean	11.07	7.83	94.91	561.84	611.54	329.95
2008/09 Horticulture median	0.00	0.00	0.00	123.48	85.15	447.86
2009/10 Horticulture mean	9.07	7.37	45.91	401.64	432.41	237.53
2009/10 Horticulture median	0.00	0.00	0.00	45.07	42.54	277.41

Purchased concentrates costs for horticulture farms for 2008/09 and 2009/10.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Pigs mean	70072.02	70072.02	none	531.46	531.46	none
2008/09 Pigs median	6566.77	6566.77	none	596.68	596.68	none
2009/10 Pigs mean	26551.94	26551.94	none	528.32	528.32	none
2009/10 Pigs median	3884.51	3884.51	none	594.78	594.78	none

Purchased concentrates costs for pig farms for 2008/09 and 2009/10.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Poultry mean	136299.13	154654.71	10682.53	1213.95	1218.74	1137.94
2008/09 Poultry median	5531.11	5947.95	1390.09	549.81	550.24	285.45
2009/10 Poultry mean	150909.26	164764.07	Insuff. Data	1173.29	1228.03	Insuff. data
2009/10 Poultry median	8392.87	8719.85	Insuff. data	592.73	592.47	Insuff. data

Purchased concentrates costs for poultry farms for 2008/09 and 2009/10.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Dairy mean	674.40	689.62	560.48	343.43	335.47	400.08
2008/09 Dairy median	602.57	609.31	543.30	338.18	333.58	409.72
2009/10 Dairy mean	649.50	666.08	521.05	327.92	323.40	362.55
2009/10 Dairy median	581.42	588.21	485.35	319.10	313.35	364.79

Purchased concentrates costs for dairy farms for 2008/09 and 2009/10.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 LFA grazing livestock mean	99.74	103.75	70.72	97.87	100.07	87.90
2008/09 LFA grazing livestock median	71.53	75.38	50.43	86.55	90.22	64.63
2009/10 LFA grazing livestock mean	99.43	103.88	61.16	98.01	100.61	76.02
2009/10 LFA grazing livestock median	72.88	76.55	41.11	84.45	87.20	51.57

Purchased concentrates costs for LFA grazing livestock for 2008/09 and 2009/10.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	145.11	163.33	36.09	84.35	92.40	37.59
2008/09 Lowland grazing livestock median	64.27	74.44	11.06	57.18	62.62	15.14
2009/10 Lowland grazing livestock mean	154.78	173.14	24.75	84.26	91.88	28.49
2009/10 Lowland grazing livestock median	70.22	82.07	10.11	60.19	66.23	12.36

Purchased concentrates costs for lowland grazing livestock 2008/09 and 2009/10.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Mixed mean	366.27	377.66	281.44	197.64	209.00	95.87
2008/09 Mixed median	72.43	76.27	31.13	76.65	78.31	28.30
2009/10 Mixed mean	307.07	285.84	477.86	193.17	196.02	170.23
2009/10 Mixed median	70.59	71.16	39.80	76.07	78.79	35.10

Purchased concentrates costs for mixed farms for 2008/09 and 2009/10.

	Purchased concentrates cost/ UAA			Purchased concentrates cost/LU		
	All	Conventional	Organic	All	Conventional	Organic
2008/09 Other mean	219.69	219.69	none	111.62	111.62	none
2008/09 Other median	15.59	15.59	none	21.11	21.11	none
2009/10 Other mean	164.26	164.26	none	125.62	125.62	none
2009/10 Other median	15.04	15.04	none	22.71	22.71	none

Purchased concentrates costs for “other” farms 2008/09 and 2009/10.

Appendix D - Intensification indicator

	Intensification indicator	
average	5246.36	
median	226.08	
	Conventional	Organic
Conv/org average	5735.56	571.52
Conv /org median	236.95	75.54
Conv/org min	0.00	-6.38
Conv/org max	3601700.00	38440.56
Con/org stdev	98141.8641	3257.530655
Conv/org sample	2237	188

Intensification indicator 2008/09 across all farms and then split into organic and conventional farms.

	Intensification indicator	
average	4940.54	
median	258.51	
	Conventional	Organic
Conv/org average	5380.62	576.59
Conv /org median	273.10	62.83
Conv/org min	0.00	-9.13
Conv/org max	3559626.67	24963.23
Conv/org stdev	88248.17	2670.43
Conv/org sample	2253	190

Intensification indicator 2009/10 across all farms and then split into organic and conventional farms.

	Intensification indicator		
	All	Conventional	Organic
2008/09 cereals mean	221.03	229.67	21.97
2008/09 cereals median	221.90	226.83	10.32
2009/10 cereals mean	265.43	278.92	17.70
2009/10 cereals median	268.63	274.42	8.23

Intensification indicator for cereals farms for 2008/09 and 2009/10.

	Intensification indicator		
	All	Conventional	Organic
2008/09 General cropping mean	296.25	309.06	68.37
2008/09 General cropping median	251.20	260.79	49.07
2009/10 General cropping mean	334.96	343.96	264.71
2009/10 General cropping median	301.09	311.51	40.31

Intensification indicator for general cropping farms for 2008/09 and 2009/10.

	Intensification indicator		
	All	Conventional	Organic
2008/09 Horticulture mean	7055.29	7259.00	150.46
2008/09 Horticulture median	851.92	886.15	32.29
2009/10 Horticulture mean	6754.91	6966.95	3782.91
2009/10 Horticulture median	776.74	838.44	142.67

Intensification indicator for horticulture farms for 2008/09 and 2009/10.

	Intensification indicator		
	All	Conventional	Organic
2008/09 Pigs mean	70124.70	70124.70	none
2008/09 Pigs median	6580.28	6580.28	none
2009/10 Pigs mean	26627.00	26627.00	none
2009/10 Pigs median	3886.09	3886.09	none

Intensification indicator for pig farms for 2008/09 and 2009/10.

	Intensification indicator		
	All	Conventional	Organic
2008/09 Poultry mean	136312.25	154667.10	10703.71
2008/09 Poultry median	5531.11	5947.95	1405.01
2009/10 Poultry mean	150929.13	164785.85	insufficient data
2009/10 Poultry median	8392.87	8719.85	insufficient data

Intensification indicator for poultry farms for 2008/09 and 2009/10.

	Intensification indicator		
	All	Conventional	Organic
2008/09 Dairy mean	810.74	842.78	573.63
2008/09 Dairy median	733.85	759.87	543.30
2009/10 Dairy mean	794.55	828.46	529.41
2009/10 Dairy median	719.97	755.23	490.19

Intensification indicator for dairy farms for 2008/09 and 2009/10.

	Intensification indicator		
	All	Conventional	Organic
2008/09 LFA grazing livestock mean	140.27	147.64	78.71
2008/09 LFA grazing livestock median	107.56	114.93	59.97
2009/10 LFA grazing livestock mean	144.75	153.26	68.36
2009/10 LFA grazing livestock median	116.78	126.71	50.62

Intensification indicator for LFA grazing livestock for 2008/09 and 2009/10.

	Intensification indicator		
	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	191.97	217.23	39.24
2008/09 Lowland grazing livestock median	108.54	133.66	15.60
2009/10 Lowland grazing livestock mean	209.29	234.58	31.94
2009/10 Lowland grazing livestock median	109.82	131.94	13.01

Intensification indicator for lowland grazing livestock 2008/09 and 2009/10.

	Intensification indicator		
	All	Conventional	Organic
2008/09 Mixed mean	488.08	512.02	297.34
2008/09 Mixed median	200.07	215.56	80.38
2009/10 Mixed mean	442.80	436.06	497.00
2009/10 Mixed median	207.57	216.13	72.93

Intensification indicator for mixed farms for 2008/09 and 2009/10.

	Intensification indicator		
	All	Conventional	Organic
2008/09 Other mean	228.21	228.21	none
2008/09 Other median	18.31	18.31	none
2009/10 Other mean	176.00	176.00	none
2009/10 Other median	24.96	24.96	none

Intensification indicator for “other” farms 2008/09 and 2009/10.

Appendix E - Agri-environmental scheme payments

	Agri-env scheme payments / UAA	
average	37.86	
median	28.15	
	Conventional	Organic
Conv/org average	30.40	100.34
Conv /org median	26.17	76.93
Conv/org min	0.00	0.00
Conv/org max	827.35	479.33
Con/org stdev	45.09	79.74
Conv/org sample	2237	188

Agri-env scheme payments / UAA 2008/09 across all farms and then split into organic and conventional farms.

	Agri-env scheme payments / UAA	
average	38.48	
median	28.25	
	Conventional	Organic
Conv/org average	31.61	102.43
Conv /org median	26.06	80.46
Conv/org min	0.00	0.00
Conv/org max	488.89	490.60
Conv/org stdev	46.43	79.49
Conv/org sample	2253	190

Agri-env scheme payments / UAA 2009/10 across all farms and then split into organic and conventional farms.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 cereals mean	41.43	36.62	143.69
2008/09 cereals median	30.19	30.07	130.41
2009/10 cereals mean	44.04	38.70	143.74
2009/10 cereals median	30.21	30.10	118.90

Agri-env scheme payments / UAA for cereals farms for 2008/09 and 2009/10.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 General cropping mean	37.61	33.24	86.86
2008/09 General cropping median	29.99	29.60	70.57
2009/10 General cropping mean	38.44	34.27	86.42
2009/10 General cropping median	29.83	29.36	76.44

Agri-env scheme payments / UAA for general cropping farms for 2008/09 and 2009/10.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 Horticulture mean	11.03	9.78	46.85
2008/09 Horticulture median	0.00	0.00	0.00
2009/10 Horticulture mean	10.67	9.54	33.70
2009/10 Horticulture median	0.00	0.00	0.00

Agri-env scheme payments / UAA for horticulture farms for 2008/09 and 2009/10.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 Pigs mean	32.92	32.92	None
2008/09 Pigs median	0.00	0.00	None
2009/10 Pigs mean	24.19	24.19	None
2009/10 Pigs median	0.00	0.00	None

Agri-env scheme payments / UAA for pig farms for 2008/09 and 2009/10.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 Poultry mean	22.93	19.14	57.07
2008/09 Poultry median	0.00	0.00	0.00
2009/10 Poultry mean	20.18	14.40	insufficient data
2009/10 Poultry median	0.00	0.00	insufficient data

Agri-env scheme payments / UAA for poultry farms for 2008/09 and 2009/10.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 Dairy mean	29.85	22.80	77.45
2008/09 Dairy median	22.21	17.79	60.65
2009/10 Dairy mean	31.10	23.93	85.35
2009/10 Dairy median	23.26	19.52	60.50

Agri-env scheme payments / UAA for dairy farms for 2008/09 and 2009/10.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 LFA grazing livestock mean	45.37	35.16	108.66
2008/09 LFA grazing livestock median	30.56	28.18	95.58
2009/10 LFA grazing livestock mean	47.19	37.47	125.82
2009/10 LFA grazing livestock median	31.63	29.75	93.19

Agri-env scheme payments / UAA for LFA grazing livestock for 2008/09 and 2009/10.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	49.30	36.04	117.80
2008/09 Lowland grazing livestock median	29.92	28.75	97.05
2009/10 Lowland grazing livestock mean	51.61	40.04	116.31
2009/10 Lowland grazing livestock median	30.00	29.04	90.49

Agri-env scheme payments / UAA for lowland grazing livestock 2008/09 and 2009/10.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 Mixed mean	44.70	35.11	123.78
2008/09 Mixed median	30.42	29.97	100.96
2009/10 Mixed mean	43.40	37.93	87.37
2009/10 Mixed median	30.22	29.77	69.89

Agri-env scheme payments / UAA for mixed farms for 2008/09 and 2009/10.

	Agri-env scheme payments / UAA		
	All	Conventional	Organic
2008/09 Other mean	18.41	18.41	none
2008/09 Other median	0.00	0.00	none
2009/10 Other mean	12.01	12.01	None
2009/10 Other median	0.00	0.00	none

Agri-env scheme payments / UAA for “other” farms 2008/09 and 2009/10.

Appendix F - Shannon diversity index

	Shannon diversity index	
average	0.3949	
median	0.0000	
	Conventional	Organic
Conv/org average	0.4078	0.2641
Conv /org median	0.0000	0.0000
Conv/org min	0.0000	0.0000
Conv/org max	1.7184	1.5676
Con/org stdev	0.5003	0.4166
Conv/org sample	2205	186

Shannon diversity index 2008/09 across all farms and then split into organic and conventional farms.

	Shannon diversity index	
average	0.3888	
median	0.0000	
	Conventional	Organic
Conv/org average	0.3997	0.2619
Conv /org median	0.0000	0.0000
Conv/org min	0.0000	0.0000
Conv/org max	1.7557	1.5590
Conv/org stdev	0.5054	0.4138
Conv/org sample	2209	188

Shannon diversity index 2009/10 across all farms and then split into organic and conventional farms.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 cereals mean	0.9860	0.9901	0.9466
2008/09 cereals median	1.0329	1.0342	0.9735
2009/10 cereals mean	0.9934	1.0045	0.8130
2009/10 cereals median	1.0555	1.0583	0.6919

Shannon diversity index for cereals farms for 2008/09 and 2009/10.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 General cropping mean	1.1153	1.1280	1.0182
2008/09 General cropping median	1.1846	1.2017	1.1343
2009/10 General cropping mean	1.1269	1.1360	1.0359
2009/10 General cropping median	1.1891	1.1891	0.9987

Shannon diversity index for general cropping farms for 2008/09 and 2009/10.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 Horticulture mean	0.1325	0.1309	0.1750
2008/09 Horticulture median	0.0000	0.0000	0.0000
2009/10 Horticulture mean	0.1055	0.0983	0.1294
2009/10 Horticulture median	0.0000	0.0000	0.0000

Shannon diversity index for horticulture farms for 2008/09 and 2009/10.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 Pigs mean	0.2933	0.2933	None
2008/09 Pigs median	0.0000	0.0000	None
2009/10 Pigs mean	0.2760	0.2760	none
2009/10 Pigs median	0.0000	0.0000	none

Shannon diversity index for pig farms for 2008/09 and 2009/10.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 Poultry mean	0.1167	0.1027	0.2228
2008/09 Poultry median	0.0000	0.0000	0.0000
2009/10 Poultry mean	0.1098	0.1087	insufficient data
2009/10 Poultry median	0.0000	0.0000	insufficient data

Shannon diversity index for poultry farms for 2008/09 and 2009/10.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 Dairy mean	0.1860	0.1881	0.1453
2008/09 Dairy median	0.0000	0.0000	0.0000
2009/10 Dairy mean	0.1863	0.1877	0.1526
2009/10 Dairy median	0.0000	0.0000	0.0000

Shannon diversity index for dairy farms for 2008/09 and 2009/10.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 LFA grazing livestock mean	0.0310	0.0328	0.0235
2008/09 LFA grazing livestock median	0.0000	0.0000	0.0000
2009/10 LFA grazing livestock mean	0.0320	0.0301	0.0527
2009/10 LFA grazing livestock median	0.0000	0.0000	0.0000

Shannon diversity index for LFA grazing livestock for 2008/09 and 2009/10.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	0.1476	0.1622	0.0458
2008/09 Lowland grazing livestock median	0.0000	0.0000	0.0000
2009/10 Lowland grazing livestock mean	0.1234	0.1393	0.0078
2009/10 Lowland grazing livestock median	0.0000	0.0000	0.0000

Shannon diversity index for lowland grazing livestock 2008/09 and 2009/10.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 Mixed mean	0.7731	0.8025	0.5083
2008/09 Mixed median	0.7249	0.7782	0.6282
2009/10 Mixed mean	0.7501	0.7792	0.5162
2009/10 Mixed median	0.7295	0.7508	0.5802

Shannon diversity index for mixed farms for 2008/09 and 2009/10.

	Shannon diversity index		
	All	Conventional	Organic
2008/09 Other mean	0.0205	0.0205	none
2008/09 Other median	0.0000	0.0000	none
2009/10 Other mean	0.0000	0.0000	none
2009/10 Other median	0.0000	0.0000	none

Shannon diversity index for “other” farms 2008/09 and 2009/10.

Appendix G - Livestock unit per forage grazing

	Livestock unit per forage grazing	
average	11.12	
median	1.13	
	Conventional	Organic
Conv/org average	12.19	1.67
Conv /org median	1.16	1.05
Conv/org min	0.00	0.00
Conv/org max	7820.00	51.64
Con/org stdev	212.82	4.49
Conv/org sample	2101	185

Livestock unit per forage grazing 2008/09 across all farms and then split into organic and conventional farms.

	Livestock unit per forage grazing	
average	14.19	
median	1.11	
	Conventional	Organic
Conv/org average	15.52	1.58
Conv /org median	1.15	1.00
Conv/org min	0.00	0.00
Conv/org max	9171.33	58.17
Conv/org stdev	281.83	4.85
Conv/org sample	2111	185

Livestock unit per forage grazing 2009/10 across all farms and then split into organic and conventional farms.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 cereals mean	0.8875	0.9092	0.5149
2008/09 cereals median	0.1501	0.1234	0.5294
2009/10 cereals mean	1.0448	1.0819	0.4260
2009/10 cereals median	0.2259	0.1875	0.4406

Livestock unit per forage grazing for cereals farms for 2008/09 and 2009/10.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 General cropping mean	1.4112	1.4717	1.2247
2008/09 General cropping median	0.0410	0.0000	1.0864
2009/10 General cropping mean	1.4540	1.5212	1.1438
2009/10 General cropping median	0.0827	0.0149	0.8817

Livestock unit per forage grazing for general cropping farms for 2008/09 and 2009/10.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Horticulture mean	0.2431	0.2329	0.5089
2008/09 Horticulture median	0.0000	0.0000	0.7091
2009/10 Horticulture mean	0.1971	0.1887	0.4349
2009/10 Horticulture median	0.0000	0.0000	0.5917

Livestock unit per forage grazing for horticulture farms for 2008/09 and 2009/10.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Pigs mean	281.8653	281.8653	none
2008/09 Pigs median	20.8837	20.8837	none
2009/10 Pigs mean	176.6276	176.6276	none
2009/10 Pigs median	16.0683	16.0683	none

Livestock unit per forage grazing for pig farms for 2008/09 and 2009/10.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Poultry mean	187.6699	213.7262	9.3986
2008/09 Poultry median	15.2494	16.2959	5.1127
2009/10 Poultry mean	203.1604	222.8455	insufficient data
2009/10 Poultry median	15.0290	15.8640	insufficient data

Livestock unit per forage grazing for poultry farms for 2008/09 and 2009/10.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Dairy mean	2.0556	2.1285	1.4979
2008/09 Dairy median	1.9737	2.0624	1.4504
2009/10 Dairy mean	2.0729	2.1491	1.4771
2009/10 Dairy median	1.9625	2.0756	1.3960

Livestock unit per forage grazing for dairy farms for 2008/09 and 2009/10.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 LFA grazing livestock mean	1.0027	1.0212	0.8048
2008/09 LFA grazing livestock median	0.9301	0.9618	0.8192
2009/10 LFA grazing livestock mean	1.0004	1.0232	0.8215
2009/10 LFA grazing livestock median	0.9259	0.9507	0.8263

Livestock unit per forage grazing for LFA grazing livestock for 2008/09 and 2009/10.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	1.4224	1.4969	1.0047
2008/09 Lowland grazing livestock median	1.2552	1.3064	0.8910
2009/10 Lowland grazing livestock mean	1.4869	1.5705	0.9187
2009/10 Lowland grazing livestock median	1.2103	1.3233	0.8262

Livestock unit per forage grazing for lowland grazing livestock 2008/09 and 2009/10.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Mixed mean	4.2454	4.3248	3.8126
2008/09 Mixed median	1.4407	1.4820	1.1063
2009/10 Mixed mean	55.1564	61.6331	3.9056
2009/10 Mixed median	1.3202	1.3948	1.0127

Livestock unit per forage grazing for mixed farms for 2008/09 and 2009/10.

	Livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Other mean	1.1233	1.1233	none
2008/09 Other median	0.8883	0.8883	none
2009/10 Other mean	1.1599	1.1599	none
2009/10 Other median	0.9396	0.9396	none

Livestock unit per forage grazing for “other” farms 2008/09 and 2009/10.

Appendix G2: Grazing livestock unit per forage grazing

	Grazing livestock unit per forage grazing	
average	1.14	
median	1.01	
	Conventional	Organic
Conv/org average	1.16	1.02
Conv /org median	1.03	0.97
Conv/org min	0.00	0.00
Conv/org max	18.39	3.13
Con/org stdev	1.21	0.56
Conv/org sample	2101	185

Grazing livestock unit per forage grazing 2008/09 across all farms and then split into organic and conventional farms.

	Grazing livestock unit per forage grazing	
average	1.18	
Median	0.99	
	Conventional	Organic
Conv/org average	1.20	0.97
Conv /org median	1.02	0.97
Conv/org min	0.00	0.00
Conv/org max	33.49	3.32
Conv/org stdev	1.69	0.55
Conv/org sample	2111	185

Grazing livestock unit per forage grazing 2009/10 across all farms and then split into organic and conventional farms.

	Grazing livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 cereals mean	0.5961	0.6032	0.5111
2008/09 cereals median	0.0745	0.0542	0.5294
2009/10 cereals mean	0.6044	0.6163	0.4209
2009/10 cereals median	0.1282	0.1011	0.4406

Grazing livestock unit per forage grazing for cereals farms for 2008/09 and 2009/10.

	Grazing livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 General cropping mean	0.6971	0.7018	0.9837
2008/09 General cropping median	0.0000	0.0000	0.9173
2009/10 General cropping mean	0.7490	0.7633	0.8695
2009/10 General cropping median	0.0000	0.0000	0.8817

Grazing livestock unit per forage grazing for general cropping farms for 2008/09 and 2009/10.

	Grazing livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Horticulture mean	0.1878	0.1881	0.2576
2008/09 Horticulture median	0.0000	0.0000	0.0000
2009/10 Horticulture mean	0.1326	0.1292	0.2500
2009/10 Horticulture median	0.0000	0.0000	0.0000

Grazing livestock unit per forage grazing for horticulture farms for 2008/09 and 2009/10.

	Grazing livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Pigs mean	0.2422	0.2422	none
2008/09 Pigs median	0.0000	0.0000	none
2009/10 Pigs mean	0.2453	0.2453	none
2009/10 Pigs median	0.0000	0.0000	none

Grazing livestock unit per forage grazing for pig farms for 2008/09 and 2009/10.

	Grazing livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Poultry mean	0.2484	0.2123	0.5784
2008/09 Poultry median	0.0000	0.0000	0.6295
2009/10 Poultry mean	1.0873	1.1499	insufficient data
2009/10 Poultry median	0.0000	0.0000	insufficient data

Grazing livestock unit per forage grazing for poultry farms for 2008/09 and 2009/10.

	Grazing livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Dairy mean	2.0382	2.1095	1.4896
2008/09 Dairy median	1.9719	2.0559	1.4504
2009/10 Dairy mean	2.0543	2.1290	1.4700
2009/10 Dairy median	1.9495	2.0599	1.3941

Grazing livestock unit per forage grazing for dairy farms for 2008/09 and 2009/10.

	Grazing livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 LFA grazing livestock mean	0.9985	1.0182	0.7824
2008/09 LFA grazing livestock median	0.9286	0.9598	0.8192
2009/10 LFA grazing livestock mean	0.9966	1.0197	0.8125
2009/10 LFA grazing livestock median	0.9167	0.9464	0.7730

Grazing livestock unit per forage grazing for LFA grazing livestock for 2008/09 and 2009/10.

	Grazing livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	1.4174	1.4911	1.0043
2008/09 Lowland grazing livestock median	1.2399	1.2953	0.8910
2009/10 Lowland grazing livestock mean	1.4771	1.5593	0.9180
2009/10 Lowland grazing livestock median	1.2017	1.3003	0.8262

Grazing livestock unit per forage grazing for lowland grazing livestock 2008/09 and 2009/10.

	Grazing livestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Mixed mean	1.4608	1.5111	1.0368
2008/09 Mixed median	1.2341	1.2646	0.9995
2009/10 Mixed mean	1.5192	1.5960	0.9117
2009/10 Mixed median	1.1868	1.2446	0.9141

Grazing livestock unit per forage grazing for mixed farms for 2008/09 and 2009/10.

	Grazing ivestock unit per forage grazing		
	All	Conventional	Organic
2008/09 Other mean	1.1222	1.1222	none
2008/09 Other median	0.8883	0.8883	none
2009/10 Other mean	1.1599	1.1599	none
2009/10 Other median	0.9396	0.9396	none

Grazing livestock unit per forage grazing for “other” farms 2008/09 and 2009/10.

Appendix H: Proportion of land that is woodland, permanent grass, or fallow

	Proportion of land that is woodland, permanent grass or fallow	
average	0.5217	
median	0.5366	
	Conventional	Organic
Conv/org average	0.5131	0.6122
Conv /org median	0.5057	0.6521
Conv/org min	0.0000	0.0000
Conv/org max	1.0000	1.0000
Con/org stdev	0.3830	0.3321
Conv/org sample	2234	188

Proportion of land that is woodland, permanent grass or fallow 2008/09 across all farms and then split into organic and conventional farms.

	Proportion of land that is woodland, permanent grass or fallow	
average	0.5136	
median	0.5254	
	Conventional	Organic
Conv/org average	0.5083	0.5839
Conv /org median	0.5086	0.6072
Conv/org min	0.0000	0.0000
Conv/org max	1.0000	1.0000
Conv/org stdev	0.3843	0.3416
Conv/org sample	2251	190

Proportion of land that is woodland, permanent grass or fallow 2009/10 across all farms and then split into organic and conventional farms.

	Proportion of land that is woodland, permanent grass or fallow		
	All	Conventional	Organic
2008/09 cereals mean	0.1509	0.1459	0.2626
2008/09 cereals median	0.1040	0.0970	0.1591
2009/10 cereals mean	0.1479	0.1444	0.2138
2009/10 cereals median	0.0999	0.0953	0.1658

Proportion of land that is woodland, permanent grass or fallow for cereals farms for 2008/09 and 2009/10.

	Proportion of land that is woodland, permanent grass or fallow		
	All	Conventional	Organic
2008/09 General cropping mean	0.1303	0.1182	0.3183
2008/09 General cropping median	0.0604	0.0511	0.2873
2009/10 General cropping mean	0.1379	0.1234	0.3355
2009/10 General cropping median	0.0476	0.0380	0.3659

Proportion of land that is woodland, permanent grass or fallow for general cropping farms for 2008/09 and 2009/10.

	Proportion of land that is woodland, permanent grass or fallow		
	All	Conventional	Organic
2008/09 Horticulture mean	0.1571	0.1533	0.3247
2008/09 Horticulture median	0.0000	0.0000	0.0162
2009/10 Horticulture mean	0.1478	0.1409	0.3256
2009/10 Horticulture median	0.0000	0.0000	0.0162

Proportion of land that is woodland, permanent grass or fallow for horticulture farms for 2008/09 and 2009/10.

	Proportion of land that is woodland, permanent grass or fallow		
	All	Conventional	Organic
2008/09 Pigs mean	0.5861	0.5861	none
2008/09 Pigs median	0.9505	0.9505	none
2009/10 Pigs mean	0.5349	0.5349	none
2009/10 Pigs median	0.6739	0.6739	none

Proportion of land that is woodland, permanent grass or fallow for pig farms for 2008/09 and 2009/10.

	Proportion of land that is woodland, permanent grass or fallow		
	All	Conventional	Organic
2008/09 Poultry mean	0.7863	0.7929	0.7005
2008/09 Poultry median	1.0000	1.0000	0.7064
2009/10 Poultry mean	0.7132	0.7001	insufficient data
2009/10 Poultry median	1.0000	1.0000	insufficient data

Proportion of land that is woodland, permanent grass or fallow for poultry farms for 2008/09 and 2009/10.

	Proportion of land that is woodland, permanent grass or fallow		
2008/09 Dairy mean	0.6632	0.6697	0.6144
2008/09 Dairy median	0.7441	0.7458	0.6599
2009/10 Dairy mean	0.6424	0.6519	0.5732
2009/10 Dairy median	0.7003	0.7135	0.6024

Proportion of land that is woodland, permanent grass or fallow for dairy farms for 2008/09 and 2009/10.

	Proportion of land that is woodland, permanent grass or fallow		
	All	Conventional	Organic
2008/09 LFA grazing livestock mean	0.7636	0.7655	0.7171
2008/09 LFA grazing livestock median	0.8863	0.8871	0.8747
2009/10 LFA grazing livestock mean	0.7682	0.7750	0.7141
2009/10 LFA grazing livestock median	0.8859	0.8932	0.8649

Proportion of land that is woodland, permanent grass or fallow for LFA grazing livestock for 2008/09 and 2009/10.

	Proportion of land that is woodland, permanent grass or fallow		
	All	Conventional	Organic
2008/09 Lowland grazing livestock mean	0.7987	0.8005	0.8017
2008/09 Lowland grazing livestock median	0.8956	0.8959	0.8960
2009/10 Lowland grazing livestock mean	0.7871	0.7843	0.8353
2009/10 Lowland grazing livestock median	0.8805	0.8806	0.9175

Proportion of land that is woodland, permanent grass or fallow for lowland grazing livestock 2008/09 and 2009/10.

	Proportion of land that is woodland, permanent grass or fallow		
	All	Conventional	Organic
2008/09 Mixed mean	0.4450	0.4274	0.5902
2008/09 Mixed median	0.4234	0.4000	0.6373
2009/10 Mixed mean	0.4514	0.4451	0.5020
2009/10 Mixed median	0.4700	0.4477	0.5409

Proportion of land that is woodland, permanent grass or fallow for mixed farms for 2008/09 and 2009/10.

	Proportion of land that is woodland, permanent grass or fallow		
	All	Conventional	Organic
2008/09 Other mean	0.8465	0.8465	none
2008/09 Other median	1.0000	1.0000	none
2009/10 Other mean	0.8762	0.8762	none
2009/10 Other median	1.0000	1.0000	none

Proportion of land that is woodland, permanent grass or fallow for “other” farms 2008/09 and 2009/10.

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