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The Comparative Cost and Profit Analysis of Organic and Conventional Farming

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Abstract

The cost-profit relations of organic and conventional farming were examined on the basis of natural and financial data of a large agricultural - company in western Hungary and of economic models characterising private farms in eastern Hungary. The differences in cost structures reflect variable conditions relating to certain crops, but they can be well explained by the differences in the technologies used. According to the production data, in organic farming direct costs per hectare were lower in all of the four examined crops. Even cost per production unit and contribution were more favourable in three of the investigated crops. Regarding the calculation done by economy models, the costs per hectare relating to the two production methods were not significantly different. Yields in organic plant production were typically lower but costs per unit and selling prices were higher. Differences in gross profits may be explained by different yields and selling prices. In a majority of the model variations organic farming is more profitable, but the extra bio price ensuring this, in accordance with trends from literature, is not sufficient for achieving a higher profit in every year.

Keywords

organic farming, conventional farming, costs, profit

Introduction

Organic farming in Hungary developed dynamically from the middle of the 1980s until 2004. Between 2004 and 2009 declined significantly with respect to both production size and number of producers *(Czeller and Roszík, 2009; Kormosné, 2008, Willer and Kilcher, 2009)*. Studies clarifying the cost-profit relationships of organic farming in Hungary and comparing them to other farming methods could help in understanding this phenomenon.

In the literature (e.g. *Stanhill, 1990; Offermann and Nieberg, 2000; Maeder et al. 2002; Podmaniczky, 2002; Takács, 2007*) a relatively uniform condition is reflected on differences between conventional and organic farming with regard to yields, prices, costs and profit. The authors conclude that organic farming is characterised by lower yields. On the other hand most of them highlight the fact that the differences may be extremely diverse in crop cultures *(e.g. Offermann and Nieberg, 2000; Denison et al., 2004)*. The decrease in yields after conversion is replaced by growth in yields after 3 to 4 years *(Hanson et al. 1997; Pimentel et al. 2005; Kis, 2007)*. There are significant differences between authors with respect to the extent to which the yields are lower in organic farming *(Offermann and Nieberg, 2000; Maeder et al., 2002; Pimentel et al. 2005; Cavigelli et al., 2009)*.

The authors stress that it is not obvious that there is a huge difference in costs per hectare relating to the two production methods, but converting to organic farming causes a significant change in the cost structure. Lower material costs (due to the lack of fertilisers and chemicals) is typical of organic farming, while the costs of labour and machinery work (handling manures, mechanical weed control) may increase. Such a change in the cost structure is shown by several studies in different

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crops *(e.g. Hanson et al. 1997; Tzouvelekas et al., 2001; Delate et al., 2003; Pimentel et al., 2005, Gündoğmuş, 2006; McBride and Greene, 2008).*

The price of organic products is generally higher than the usual market price *(Streff and Dobbs, 2004; Greene et al., 2005),* but the attainable extra price may be different according to markets, periods and product groups (higher in vegetable, cereals; lower in products of animal origin). The extra bio price influencing the success of organic farming is not only fluctuating but it is more and more decreasing for a longer period of time. *Podmaniczky (2002)* highlights that studies aiming at comparing profit do not reflect a uniform condition, but in many cases organic farming is more profitable "till the level while the smaller variable costs and advantages coming from prices are able to equalize the smaller yields". In the majority of the eight summarising studies of Welsh (1999) organic farming regarding extra bio price was more profitable than conventional farming.

Only few studies can be found on sector-specific cost-profit analysis of organic farming in Hungary, and analyses comparing organic and conventional farming methods are even less common. *Koch (2004)* studied the efficiency of winter wheat and sunflower production on the basis of data of 2002 in the case of six organic farms and one conventional farm. Yields in both crops were much lower in organic farming (especially in sunflower); however, the costs per hectare did not reflect significant differences. Due to the extra bio price and the highlighted subsidies wheat production was much more profitable in organic farms; on the other hand sunflower production was more favourable in conventional farming thanks to the much higher yields. The paper does not contain any data suitable for analysing cost structure. *Balikó (2006)* introduces the ratio of major cost elements of conventional wheat production for 2004 in the case of the Bólyi corporation but unfortunately detailed data are not included. *Mile (2006)* compared different farming methods (conventional, integrated, organic) on the basis of several indicators (yields, revenue, costs, profit) and concluded that organic products ensure the highest revenue with a safe purchasing market. Detailed cost data cannot be found even in this work.

Gyarmati (2007) analysed data of three corporations where organic and conventional farming takes place within an enterprise under similar conditions, thus the results of the two production methods may be compared. In the period between 2000 and 2005, the yields of conventional farming were typically higher, but this higher ratio depends on periods and crops. In the case of maize for silage and sunflower higher yields were typical in conventional farming. The costs per unit of certain products were different, so the author did not draw conclusions relating to this fact because of the lack of detailed cost data. It is also difficult to draw conclusions from comparing profit per hectare especially if calculations do not include the subsidies. Kis and Takácsné (2007) collected data for winter wheat for the period between 1996 and 2006 in the case of organic farms with the help of a survey and these data were compared to the national average. They concluded that yields in organic farming reached 73 to 100% of the conventional yields. 98% of the 110 organic farmers polled realised a maximum yield decrease of 30% comparing to conventional farming (*Kis, 2007*). The price advantage of organic wheat is extremely significant at the beginning of the studied period (twice as much or three times higher), but the price decreased to 25 to 30% at the end of the period. The costs per unit of organic wheat reflect huge differences. For example in 1999 the cost per unit of wheat ranged from 17500 HUF to 93 thousand HUF; however the averages reached 75 to 110% of the national one.

Based on the facts mentioned above, our investigations had two objectives.

1. Comparing the cost and profit relations of conventional and organic farming in four crops (winter wheat, maize, sunflower, rape) on the basis of data of an enterprise located in Transdanubia dealing with both of the farming methods.
2. Making a comparative analysis of cost and profit relations of organic and conventional farming according to model calculations based on producer's data collection, at different levels of subsidies under the conditions of Hortobágy area.

Database and methods

Regarding the dual objectives, the database and methods of the investigations are divided on the basis of the objectives.

Assessment of production and financial data of a large agricultural company in western Hungary

Data collection necessary for calculations was carried out in a company which deals with both conventional and organic farming. For the comparison it was necessary that the certain crop should be cultivated using both production methods in the same year. Because of this barrier the analysis could be carried out for only one year for each of the four crops (2008 in the case of rape and 2009 in the case of the other crops).

Data collection focused on preparing field operational cost calculations. The data necessary for this were partly natural data (such as denomination and time of operations, equivalent of normal hectare, quantity of utilised materials, sowing area, yields), and partly value data (selling prices, value of utilised materials, costs of machinery work etc.). Yields depending on crop were 7 to 41% lower in organic farming, while selling prices were higher by 18 to 90%. The biggest yield penalty and the smallest price advantage were detected in rape, the biggest price benefit occurred in case of wheat (Table 1).

Table 1

Yields and prices of products from both farming practices

Denomination		Yields (t/ha)	Selling price (HUF/t)
Organic farming	Rape	2.12	122,000
	Winter wheat	3.87	57,900
	Sunflower	2.96	84,000
	Maize	7.71	40,500
Conventional farming	Rape	3.58	103,000
	Winter wheat	4.68	30,400
	Sunflower	3.20	50,000
	Maize	8.85	28,500
Organic as a percentage of conventional farming	Rape	59	118
	Winter wheat	83	190
	Sunflower	93	168
	Maize	87	142

Source: own data collection and calculation, 2009

The organic and conventional technologies typical of the company of the certain crops were constructed by processing and aggregating data at the parcel level. Costs necessary for carrying out the field operations were adapted to the field operations listed in the technologies, as well as other costs which can be connected directly to the production of that crop (land rent, cost of soil examination, insurance and other fees paid for extension service or controlling organic farming). The gained value was considered as the direct production cost of the crop and the value projected to a single yield was considered as direct cost per unit.

Subsidies relating to the production of the crop were given to production value gained as multiplying yields and selling price3, and then this value was reduced by the direct costs determined previously. This value was considered as contribution.

$$CO = (Y \times P) + S - (Y \times DU)$$

where:

CO: contribution, HUF/ha
Y: yield, t/ha
P: selling price, HUF/t
S: subsidy, HUF/ha
DU: direct cost per unit, HUF/t

The differences of contributions of organic and conventional productions were divided into elements by chain substitution (e.g. *Sztanó, 2006; Sabján and Sutus, 2009*). The contribution in conventional farming was the first step, and then data for factors influencing the contribution of conventional farming were substituted by data of organic farming step by step. During this process subsidies were neglected as they were the same in both farming methods and did not have any effects on differences of contributions.

Investigation by economy-models based on production and financial data of a private farm in a subregion located in eastern Hungary.

Producer's datasheets were filled in among farms dealing with arable plant production and animal husbandry. The arable crops typical to the area (Hortobágy) include wheat, barley, rye, sorghums, sunflower, rape, pea and lucerne. Animal keeping may be characterised by sheep and cattle breeding, animal husbandry based on fodder is not significant. Data collection concentrated on technologies, data of purchases and selling, asset supply and information on overhead costs besides the general introduction of farming. On the basis of professional considerations, four typical organic and four conventional farms were selected regarding the following aspects: the production structure should be similar in the farms, their production standard should be acknowledged by local experts and the organic farms should already be converted farms.

The average farm size of the organic sample is 58 hectares. Beside winter wheat (30%) and sunflower (18%), lucerne, barley, oat, pea and mustard are continuously present in the crop structure. Two farmers of the four keep Hungarian merino on grassland in 0.4 livestock unit density. The average farm size of the conventional sample is 76 hectares. Beside winter wheat (55%), sunflower (20%), barley and mustard are present in a great ratio in the crop structure. Three of the conventional farms deal with ewe keeping. Every farm in the sample bases their field operation on family labour, but hire external labour for certain seasonal works (e.g. sheep shearing).

[3] Single Area Payment Scheme (SAPS) and the national TOP-UP, as well as refund of gas oil fiscal tax

Table 2

The crop structure of model farms in arable land of 40 hectares

Unit: %

Crop	Years of crop rotation						
	1	2	3	4	5	6	7
Wheat	25	25	25	-	25	25	50
Oat	-	-	25	25	25	-	-
Spring barley	-	-	-	-	-	25	-
Sunflower	25	-	-	-	25	25	25
Lucerne	25	25	25	25	-	-	-
Mustard	-	25	25	25	-	-	-
Pea	25	25	-	25	25	25	25
Total	100	100	100	100	100	100	100

Source: own calculation, 2009

Table 3

The yields and product prices of organic farming as a percentage of conventional yields and product prices

Unit: %

Denomination	Product	Year			Average of three years (2006-2008)
		2006	2007	2008	
Yields	wheat	86	90	84	87
	oat	93	91	87	90
	spring barley	86	91	86	87
	sunflower	91	100	86	91
	lucerne hay	94	98	99	97
	mustard	90	100	75	87
	pea silage	78	83	76	79
Product prices	wheat	176	158	147	159
	oat	172	148	149	154
	spring barley	132	146	126	135
	sunflower	146	131	143	139
	lucerne hay	100	100	100	100
	mustard	121	106	109	111
	pea silage	100	100	100	100
	straw	100	100	100	100

Source: own data collection and calculation, 2009

The most common practices were taken into consideration in the case of characteristics of farms as well as technological processes (e.g. machinery connections of field operations), and in the case of data being averaged (e.g. yields), weighted arithmetical mean was calculated. Data from the registration of family farms did not allow a detailed cost-profit analysis, the comparison was only partial, thus basing on the features of the two sets of four farms and supplementing them by calculated data, an organic and a conventional model farm were constructed. When compiling the model, the principle *ceteris paribus* was followed to the greatest degree; the two-farm model contains only differences which are compulsory consequences of the different farming methods (technologies, prices, subsidies, extra costs of controlled production etc.). The size and production structure of the two model farms are the same, as are their natural conditions. The size of arable land is 40 hectares; half of it is rented. On the grassland of 20 hectares of partly rented, the average number of ewes is 50 (milking lambs are sold). The crop rotation recurring after eight years is the same in the two models. As the structure of the produced plants are different in certain years (Table 2), and it influences the revenue and the costs, the models were developed for seven years in accordance with the seven-year-cycle of the crop rotation in a way that prices and subsidies of sample farms from the data collection of producers were considered as the same within one model variety. In this way it made the examination of a seven-year-period possible under the same price and subsidy conditions.

The average yields of the organic farm are typically lower by 10 to 20%, but differences are significant in crops. The price advantage of organic farming is not common in every crop; it reaches 30 to 60% crops of selling purposes determining revenue (Table 3).

Subsidies of the year 2007 were built in the models; this year is not typical regarding the yields of plant production and product prices, thus 4-4 model variations were created with the average yields and product prices of different years: average yields of the year 2005 to 2007 and product prices of the year 2007; yields and product prices of the year 2006; yields and product prices of the year 2007; yields and product prices of the year 2008. Each of the 4-4 model variations were developed to 5-5 subsidy levels[4], which resulted in 20-20 model variations for organic and conventional farming.

Beside yields, prices and technologies the 20-20 model varieties were compared from the aspect of labourless costs neglecting the wages of the entrepreneur (but containing the cost of the required external labour), labourless per unit production cost, subsidies as well as gross profit involving the wage of the entrepreneur. The gross profit (GP) was calculated as revenue containing subsidies minus labourless costs (containing overhead costs). The deviations of gross profit were separated to the effect of five factors by chain substitution in a way that in every model variety, the gross profit in conventional farming was the first step, and then data of factors influencing gross profit of conventional farming were substituted by the data of the organic farms step by step

$$GP = (C \times Y \times P)+(C \times S)-(C \times Y \times CU)$$

The five factors are the following:

C: *Capacity* – number of ewes (item), field size (hectare). These are the same at each subsidy level, except for subsidy levels IV and V, due to the AEM national rules that require a given size of "organic compensational territory" in the case of organic arable land AEM programme and, because of this, grass boundaries of eight percentages of the parcels were calculated in the organic farming model.

[4] The five levels of subsidies: I. No subsidy. II. Level of SAPS and TOP-UP. III. Subsidies of II. level supplemented by subsidies of less favoured areas. IV. Subsidies of II. level supplemented by basic target programmes of agri-environmental farming measures (AEM) in the conventional model and by target programmes of plant production and grassland farming in organic farming. V. Subsidies of level II supplemented by subsidies of less-favoured areas and the mentioned target programmes of AEM.

Y: Yield (amount of product per ewe or hectare, in natural measurement units).

CU: *Cost per production unit, defined as direct plus overhead costs minus labour costs* (HUF/kg, HUF/t).

P: *Market price* (HUF/kg, HUF/t).

S: *Subsidies* (HUF/ewe, HUF/ha).

The applied calculations are quite the same as those in most of the analytical methodology books. The only difference is that our data do not cover only one product or one year, so the calculations are applied for the seven years of the crop rotation and all the products as a whole.

Results

Production and financial data in a big company

The cost per hectare in organic farming was lower in every case than that of conventional farming. The difference depending on crops is 15 to 33% of the costs of conventional technology, which is 25 to 54 thousand HUF/ha (Table 4). The lower cost per hectare of organic farming in three crops (wheat, sunflower and maize) compensated for the lower yields, thus the direct production cost per unit is lower than in conventional production. In rape produced in 2008, in spite of the lower cost per hectare by 21%, because of the significant yield penalty a higher cost per unit was realised in organic farming.

The yield penalty of 41% for rape could not be compensated by the extra bio price of 18%, in this way the production value per hectare reached in organic farming lags behind that of conventional rape production by 30%. In other crops the higher extra bio price (42 to 90%) as in rape production, the moderate (7 to 27%) yield penalty led to a significantly higher (by 24 to 57%) production value in organic farming.

In organic farming the production value minus direct production costs is relatively high even without subsidies in the case of each of the four crops. An ambivalent condition was reflected in conventional production. It is clear that winter wheat and sunflower production would have shown a deficit even without subsidies; however, the conventional rape production reached the highest contribution from all of the crops and technologies. Conventional maize production did not reflect a deficit even without subsidies, but its contribution altogether with subsidies hardly exceeds half of the contribution reached in organic farming.

Differences between costs per hectare of conventional and organic farming are shown in Table 5 on the basis of cost elements. It is clear that the lower fertiliser costs of organic farming in rape, winter wheat and maize played a dominant role in forming the differences of cost per hectare.

Table 4

Costs, cost per unit and contribution in case of the four crops

(CO1 = contribution without subsidies; CO2 = contribution with subsidies)

Denomination		Direct production cost (HUF/ha)	Direct cost per unit (HUF/t)	Production value (HUF/ha)	CO1 (HUF/ha)	CO2 (HUF/ha)
Organic	Rape	110,534	52,139	258,640	148,106	197,507
	Wheat	106,757	27,586	224,073	117,316	167,632
	Sunflower	141,906	47,941	248,640	106,734	157,050
	Maize	148,288	19,233	312,255	163,967	214,283
Conventional	Rape	140,234	39,172	368,740	228,506	277,907
	Wheat	160,294	34,251	142,272	-18,022	32,294
	Sunflower	167,145	52,233	160,000	-7,145	43,171
	Maize	187,903	21,232	252,225	64,322	114,638
Organic as a percentage of conventional farming	Rape	79	133	70	65	71
	Wheat	67	81	157	-	519
	Sunflower	85	92	155	-	364
	Maize	79	91	124	255	187

Source: own calculation, 2009

Table 5

Cost elements of organic farming compared to conventional farming

Denomination	Rape cost difference		Wheat cost difference		Sunflower cost difference		Maize cost difference	
	thousand HUF	%	thousand HUF	%	thousand HUF	%	thousand HUF	%
Fertilisation	21	68	49	91	-11	-45	21	54
Soil preparation	3	9	-2	-3	-5	-19	3	6
Sowing	2	8	-3	-6	6	24	-1	-3
Plant protection	-2	-6	9	16	32	127	14	35
Harvesting	7	23	4	7	1	4	6	14
Land rent	0	0	0	0	0	0	0	0
Other	-1	-2	-3	-5	2	9	-3	-6
Altogether	30	100	54	100	25	100	40	100

Source: own calculation, 2009

Only artificial fertiliser was used in conventional farming, while organic manure was utilised in organic farming. Organic manure has a long-term effect lasting for years, thus according to the counting practice in the company the costs of manure are calculated for four years in a decreasing rate (40-30-20-10) from year to year. Using manure on parcels occurred in different years, in this way manure cost for the first year was calculated in sunflower, that for the second year in maize, and cost for the third year in rape. The organic winter wheat parcel did not get any manure, only the crop preceding wheat utilised the nitrogen accumulated by lucerne. In sunflower the costs of fertiliser of organic farming are higher than that in conventional production. This is shown by the fact that in organic farming sunflower of the four crops received the biggest manure ration and even bacteria fertiliser.

The cost of soil preparation in rape and maize was the lowest in organic farming. In rape in conventional farming one more combinator was used in conventional farming, otherwise the soil cultivation was the same. In maize in the case of conventional farming winter ploughing, while in the case of organic farming spring ploughing was used, being cheaper because of its smaller depth. On the other hand, the soil preparation costs in winter wheat and sunflower were higher in organic farming. The surplus costs in winter wheat may be explained by the fact that the plant preceding wheat was lucerne which had to be ploughed deeply. In the case of sunflower the deep loosening in autumn caused an extra cost in organic farming.

Machinery costs of costs relating to sowing were the same in organic and conventional production; the difference came from the price of the seed, which depends obviously on variety and quality. The reason for the higher seed cost by 27% in winter wheat is the fact that first class seeds were utilised.

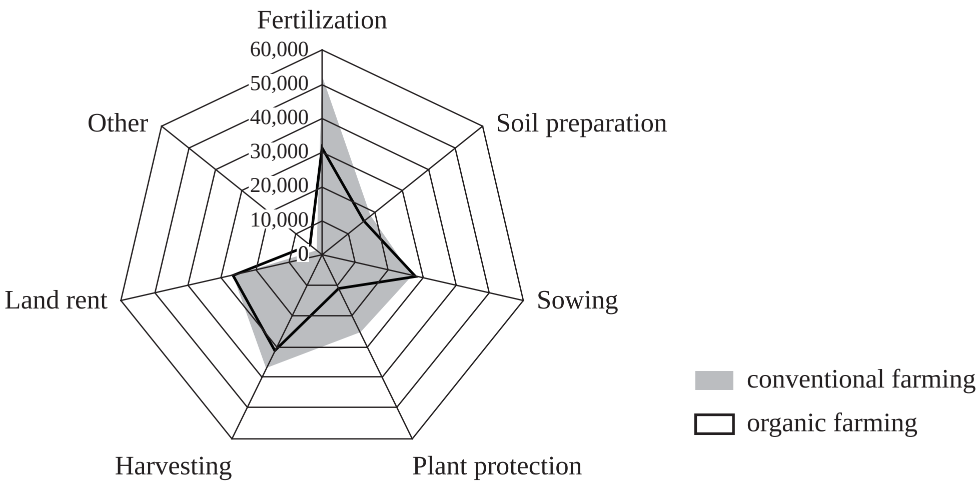

Figure 1: The costs of maize production (Unit: HUF/ha)

Source: own illustration

Machinery cost in connection with plant protection was higher in organic farming as mechanical weed control was used in several times. The difference between machinery costs is not significant compared to differences detected in costs of plant protection agents. Only a few agents were used in organic farming such as plant and soil conditioning agents and fungicides containing sulphur and mineral oil. By contrast, many agents were used in conventional farming. The cost of agent in organic farming was 18% of that of conventional farming in maize, 27% in sunflower and 60% in winter wheat. The cost of plant protection in rape was different compared to other crops. Here the cost of the agent was higher by 8% in organic farming. The reason is that soil and plant conditioning materials are used and plant protection took place twice in the biggest parcel instead of three times, unlike in other parcels.

Harvesting costs were lower in organic farming in each of the four crops which is due to the lower yields. Land rent though being not significant in value did not influence the differences, as it was the same in every crop and technology. Other costs were higher in organic farms in the majority of the crops due to the controlling fee.

Figure 1 illustrates the cost per hectare of maize production concentrating on cost elements. It is clear that the differences in costs of the two production methods are influenced by fertiliser to a great extent, by plant protection and harvesting to a significant extent, while the effect of the other cost factors is not considerable.

Table 6

The effects of factors influencing contribution per hectare

Unit: thousand HUF/ha

Denomination	Conventional CO1	Effects of factors (±)			Organic CO2
		Yields	Selling price	Cost per unit	
Rape	278	-93	40	-27	198
Winter wheat	32	3	106	26	167
Sunflower	43	1	100	13	157
Maize	115	-8	92	15	214

Source: own calculation, 2009

Table 6 contains the results of chain substitution. It is clear that in crops (winter wheat, sunflower and maize) where the contribution of organic farming was higher, higher prices played an important role in realising differences. In case of rape, the contribution of conventional farming was more favourable, due to the fact that the significant yield advantage of rape production could not be compensated for by the moderate price advantage of organic farming.

Results of comparing the economy-models

The differences regarding cost per ewe and per hectare between the two farming methods (Table 7) were not significant. A difference exceeding 10% may be found only in winter wheat in conventional farming at the first three subsidy levels, the biggest difference may be experienced in pea and barley in organic farming, but it reaches 15 to 16% at none of the subsidy levels.

In the case of winter wheat the material cost per hectare between conventional and organic farms was not significantly different; the costs of plant protection and fertilising were compensated for by the costs of soil and plant conditioning agents in organic farming, as well as the much more expensive seed. The extra cost of organic farming is mainly caused by the extra machinery cost in wheat, which may be explained by the more careful seedbed preparation and weed combing. In barley the extra cost of conventional production is due to the higher material cost (costs of fertiliser and plant protecting agent). The cost per hectare in pea silage is higher in conventional farming because of partly the surplus of material cost (fertiliser, bale net in accordance with the greater yields) and partly the surplus of machinery costs (fertilising, baling in accordance with greater yields).

On this basis, significant differences have not been realised relating to cost per ewe and per hectare between the two farming methods, but there are considerable differences in the cost structure and in costs per unit. Table 8 represents the effects of technologies on costs of field operations highlighting the examples of barley and sunflower (Table 8 does not contain overhead costs). It is clear that the cost of soil preparation in organic farming is higher due to the more careful seedbed preparation. The higher costs of using nutrients in conventional farming is in accordance with fertilising, while the higher cost of plant cultivation is in connection with the use of plant protection agents.

Table 7

Costs per ewe and hectare regarding average yields of the years 2005 to 2007 and product prices of the year 2007

Model, unit	Branch	Subsidy levels				
		I.	II.	III.	IV.	V.
Organic	HUF/ewe					
	Sheep keeping	25,022	25,031	25,504	27,987	27,987
	HUF/ha					
	Wheat	150,734	150,931	151,908	143,995	143,995
	Sunflower	128,479	128,677	129,664	123,462	123,462
	Lucerne	98,334	98,533	99,274	96,413	96,413
	Pea	137,785	137,982	138,790	132,021	132,021
	Barley	109,235	109,435	110,433	105,754	105,754
	Oat	118,471	118,669	119,656	114,263	114,263
	Mustard	115,884	116,083	116,727	111,787	111,787
Organic as a percentage of conventional farming	%					
	Sheep keeping	97	97	99	102	102
	Wheat	111	111	111	104	104
	Sunflower	103	103	103	97	97
	Lucerne	98	98	98	94	94
	Pea	89	89	89	84	84
	Barley	89	89	89	85	85
	Oat	98	98	98	93	93
	Mustard	107	107	107	102	102

Source: own calculation, 2009

The differences in barley are not considered as typical or general. For example in the case of wheat (as it was reflected previously) the costs of fertilising and using plant protection may be compensated for by mechanical weed control as well as the use of permitted soil and plant conditioning agents. There is not a significant difference in the structure of costs of field operations relating to sunflower in Table 8 as in the case of barley, but the more detailed analysis shows more significant differences. The cost of fertilising per hectare is similar (12 to 14 thousand HUF) in the two farming methods, but the main reason is using artificial fertilisers in conventional farming and manure in organic farming in the case of sunflower. The cost of plant conditioning per hectare is even similar, but while its major part (72%) is the value of the used plant protecting agents in conventional farming, 100% of the plant conditioning costs is mechanical weed control (labour and machinery work). In sunflower, machinery costs take up 57% of the total direct costs in organic farming and 60% in conventional farming. There is a significant difference in the ratio of material costs (they are 34% and 14% for conventional and organic farming, respectively) and in the costs of external labour (0% for conventional farming, 17% for organic farming).

In Table 9 the average costs per unit of the four organic farming models were compared to those of the four conventional models at different subsidy levels. It is clear that the cost per unit became high in every product, which obviously cannot be explained by the organic farming itself; it reflects even the unfavourable conditions and uncertainty of scale economies. Clearing this last one would need further study. Here we only relate to the fact that the investigated model farms lag behind the size considered as viable in literature (e.g. *Baranyai and Takács*, 2007).

Table 8

Direct costs per hectare focusing on field operations

Operation, Cost group	Barley				Sunflower			
	organic		conventional		organic		conventional	
	thousand HUF/ha	%	thousand HUF/ha	%	thousand HUF/ha	%	thousand HUF/ha	%
Soil preparation	24.0	23	18.0	16	23.0	19	23.0	19
Fertilisation	12.2	12	20.3	17	12.2	10	14.4	12
Sowing	18.7	18	17.9	15	19.6	16	18.8	16
Plant conditioning	4.0	4	17.5	15	29.4	24	28.5	24
Harvesting	20.1	19	20.7	18	14.0	11	14.0	12
Ploughing after harvesting	5.0	5	5.0	4	5.0	4	5.0	4
Transport	3.8	4	4.4	4	0.9	1	0.9	1
Seed cleaning	1.8	2	2.0	2	0.9	1	0.9	1
Drying	0.0	0	0.0	0	3.3	3	3.3	3
Other costs	13.7	13	10.4	9	13.3	11	9.5	8
Altogether	103.3	100	116.2	100	121.6	100	118.3	100

Source: own calculation, 2009

There were not considerable differences between the costs per unit for lamb. It is reasonable as even the technology of ewe keeping does not contain more significant differences. The costs per unit for plant products are higher in every case in organic farming. The biggest difference may be detected in wheat (32 to 35%), as the price benefit of organic farming is the biggest in the case of this crop. It is reasonable to undertake higher costs per hectare (seeds of good quality, careful seed-bed preparation, mechanical weed control, soil and plant conditioning agents) in the case of even relatively low yields. There were significant differences in the case of mustard as well, where though the costs per hectare are higher by a few percentage points in organic farming, the yields are much lower. In pea silage in organic farming the cost per unit is higher by 12 to 15%, which indicates that the lower level of costs per hectare by 10 to 15% was over-compensated for by the yield disadvantage exceeding 20%.

Table 9 contains the average data of the four models, behind the averages, however, considerable differences evolved depending on primarily yield results. For example in the case of wheat in the model of farm dealing with organic production considering yields and prices of the year 2007 the biggest costs per unit developed at the subsidy levels of IV and V, which higher by 21% than the smallest cost per unit (organic farming in case of yields and prices of the year 2008, I subsidy level). In other crops there is a difference of 15 to 30% between the certain models.

Table 10 makes the significance of subsidies obvious in the case of both of the model farms. According to the data of Table 11 none of the farming methods would have been shown to be viable without subsidies. The conventional farming would operate with a significant deficit without subsidies on the basis of all of the four models. Supposing yields and prices of the year 2006 and in case of SAPS + TOP-UP subsidies it would not generate even the minimal wage for the owner, while on the basis of the other three models the gross profit would be 1.2 to 1.6 million HUF. By the increase of the subsidy levels a gross profit ensuring more and more respectable livelihood may be realised in the conventional model farm; the biggest is 3.3 million HUF (in the case of yields and prices of the year 2008, at the highest subsidy level).

Table 9

Labourless cost per unit in the average of the four models at different subsidy levels

Unit: HUF/kg for lambs, HUF/t for plant products

Way of production	Product	Subsidy levels				
		I.	II.	III.	IV.	V.
Organic	Lamb	1,113	1,114	1,136	1,252	1,252
	Wheat	46,719	47,013	47,120	48,663	48,663
	Sunflower	120,205	120,391	121,314	125,557	125,557
	Lucerne	15,152	15,183	15,297	16,148	16,148
	Pea	13,287	13,306	13,384	13,838	13,838
	Barley	44,906	44,994	45,434	47,427	47,427
	Oat	46,362	46,446	46,865	48,790	48,790
	Mustard	136,808	137,042	137,803	143,446	143,446
Organic as a percentage of conventional farming	Lamb	97	97	99	102	102
	Wheat	132	132	132	135	135
	Sunflower	109	109	109	112	112
	Lucerne	101	101	101	106	106
	Pea	112	112	112	115	115
	Barley	103	103	103	107	107
	Oat	110	110	110	114	114
	Mustard	121	121	120	125	125

Source: own calculation, 2009

In organic farming on the basis of two models (yields of the year 2005 to 2007 and prices of the year 2007, and yield and prices of the year 2007) a low gross profit would be generated, not enough for ensuring livelihood. According to the other two models, the deficit is considerable. In the first three models the gross profit in organic farming regarding subsidies is higher by 14 to 55% than in conventional model farms.

The ratio of subsidies from the total revenue of the entrepreneur is 24 to 30% even at the lowest level of subsidies. It may be near 50% at the highest level of subsidies. The differences of gross profit are not determined by the subsidies at all. It is clear from the data of chain substitution (Table 10), that the differences of capacities and subsidies contribute to a small ratio of the differences in gross profit, and only at subsidy levels of IV and V. Only at these subsidy levels is there a difference in the sowing area (due to the already mentioned grass boundaries) and in subsidies (basic level in the conventional model, organic target programmes in organic models).[5]

Table 10

Percentage of subsidies in the total Revenue

Unit: %

Farming method	Model	Subsidy level				
		I.	II.	III.	IV.	V.
Conventional	Yields of the years 2005 to 2007, prices of the year 2007	0	25	33	36	41
	Yields and prices of the year 2006	0	30	38	41	47
	Yields and prices of the year 2007	0	27	35	38	43
	Yields and prices of the year 2008	0	26	33	36	42
Organic	Yields of the years 2005 to 2007, prices of the year 2007	0	24	31	37	42
	Yields and prices of the year 2006	0	29	37	44	49
	Yields and prices of the year 2007	0	24	32	38	44
	Yields and prices of the year 2008	0	26	34	40	46

Source: own calculation, 2009

Most differences in gross profit are due to the differences of products per hectare, cost per unit and selling price. As considerable differences between the model farms were not realised relating to costs per hectare, the differences of costs per unit were due to the differences in yields. The differences in gross profit are determined by the ratio of yield advantage of conventional farming and price advantage of organic farming. In the case of the first three model variations in Table 11, the price advantage of organic farming prevailed in a more significantly way, but it reversed regarding yields and prices in 2008, the price advantage could not compensate for the disadvantage of organic farms in yields and cost per unit.

[5] The positive value in the Capacity column shows the fact that besides the cost per unit exceeding selling price the decrease in arable land goes with the increase of gross profit (ceteris paribus).

Table 11

Effects of Factors Influencing Gross Profit

Unit: thousand HUF

Model	Subsidy level	Conventional farming gross profit	Effect of factors (±)					Organic farm gross profit
			Capacity	Product	Cost per unit	Selling price	Subsidy	
Yields of the years 2005 to 2007, prices of the year 2007	I.	-211	0	-63	-538	1,145	0	334
	II.	1,588	0	-62	-546	1,146	0	2,125
	III.	2,383	0	-58	-554	1,146	0	2,916
	IV.	2,635	-11	-51	-682	1,054	237	3,181
	V.	3,439	-11	-51	-682	1,054	237	3,985
Yields and prices of the year 2006	I.	-1,354	0	64	-667	815	0	-1,142
	II.	445	0	65	-673	815	0	652
	III.	1,239	0	70	-684	815	0	1,440
	IV.	1,491	81	67	-803	750	237	1,823
	V.	2,295	81	67	-803	750	237	2,627
Yields and prices of the year 2007	I.	-593	0	-21	-401	1,084	0	69
	II.	1,201	0	-20	-404	1,084	0	1,861
	III.	1,996	0	-17	-411	1,084	0	2,652
	IV.	2,248	20	-14	-549	997	237	2,939
	V.	3,052	20	-14	-549	997	237	3,743
Yields and prices of the year 2008	I.	-320	0	-69	-812	794	0	-407
	II.	1,482	0	-68	-821	794	0	1,387
	III.	2,277	0	-61	-834	794	0	2,176
	IV.	2,529	-2	-53	-941	730	237	2,499
	V.	3,333	-2	-53	-941	730	237	3,303

Source: own calculation, 2009

Conclusions

On the basis of analysing data in western Hungary, it can be concluded that the cost per hectare of organic farming is lower than that of conventional production in all of the four examined crops. The difference is 15 to 33% of the costs of conventional technology depending on cultures. The reason for the cost advantage of organic farming was that less money was spent on fertilisation and plant protection. There are significant differences in the cost structure, which may be explained by the differences between organic and conventional technologies.

Yields were lower in organic farming in all of the four crops, as in the literature (*Offermann and Nieberg, 2000, Takács, 2007)* but this yield disadvantage was less than the savings in cost per hectare. On this basis the cost per production unit was the smallest in wheat, maize and sunflower.

The extra bio price spread across a considerable interval (18-90%). The highest was detected in wheat and the smallest in rape. In crops (wheat, maize, sunflower) where the contribution of organic farming was higher, the margin came from the extra bio price. The lower contribution of rape is due to the great disadvantage in yields and moderate extra bio price.

On the basis of investigation focusing on model farms in eastern Hungary, differences in costs per hectare between the two production methods were not significant. On the other hand there were significant differences in the cost structure and cost per unit. The differences of cost structure reflect a variable condition, but do not contradict the literature and may be explained by the differences in the technologies used.

Yields in organic plant production were typically lower, but the cost per production unit and selling prices were otherwise higher. None of the production methods were shown to be viable without subsidies. The differences of gross profit arose not only from the amount of subsidies but also the different yields and selling prices. In a majority of the model variations, organic farming is more profitable, but the extra bio price ensuring this is not sufficient to reach higher profit in every year according to the trends known from the literature, as is detailed in the paper of *Podmaniczky (2002)*.

The results of this analysis fit well with the results in the literature. As the price advantage of organic farming is decreasing, balanced yields and moderating the yield disadvantage will determine the future profitability of this production method. The application of knowledge based technology and decision making have to be the basis for the adequate yields and profit conditions in organic farming, the role of market conditions is becoming less important. This could be one of the answers as to why some of the farmers have turned to other production methods in the past few years.

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