

University doctoral (PhD) dissertation abstract

**Integrated (economic, social and environmental) analysis
of Hungarian agriculture in the context of the EU
accession**

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1. RESEARCH BACKGROUND AND AIMS

Hungary's EU accession in 2004 was the most significant event for the country in the last decade and will most assuredly have an influence for several decades. The comprehensive assessment of the experiences gathered during the time elapsed from the accession in terms of economic, social and environmental aspects that involve the entire national economy still remains to be accomplished, just as in the case of agriculture.

As is well-known, one of the essential elements of the European Economic Community (EEC) established by the Treaty of Rome in 1957 was the realization of Common Agricultural Policy (CAP). Its initial objectives involved *economic* and *social* approaches as well, namely: the economic goals included the increasing of agricultural productivity, the stabilization of agricultural markets, whereas the social aspects encompassed the ensuring of constant provision of food for consumers and the fair standard of living for the agricultural community. An increasing importance has been attached to *environmental* issues in the course of the reorganization, reforming of agricultural policy, aiming at integrating environmental protection into the agricultural policy by adjusting agricultural production to the impacts of climate change in order to protect the available natural resources, provide consumers with safer, healthier products, and contribute to food security.

Environmental policy was involved in the Treaty of the European Economic Community by the Single European Act, entered into force on 1 July 1987, according to which 'the requirements of environment protection constitute a part of other policies of the Community' (Szabó, 2001). In 1999, the Helsinki European Council assigned the European Commission to prepare a proposal on a long-term strategy harmonizing economic, social and environmental aspects. The 'internal component' of the strategy was adopted in 2001 by the Union during the Göteborg European Council, and then in 2002 the 'external component' of the strategy was accepted by the Barcelona European Council. These two documents collectively constituted the comprehensive Sustainable Development Strategy (SDS) of the European Union (Gáthy-Kuti-Szabó, 2006). This Strategy was first reviewed in 2005, and the *renewed Sustainable Development Strategy of the European Union* was adopted in 2006 (nffs, 2007)

The agricultural sector was undoubtedly one of the most disputed questions during the accession negotiations between the European Union and Central and Eastern European (CEE)

candidate countries, which can be explained by the special conditions of agriculture in CEE countries such as the lower level of subsidies and producer prices, the higher rate of employed persons, the higher share of agriculture in GDP, as well as by the expectations in connection with the improvement of CAP. As the Common Agricultural Policy represented almost half of the EU's budget, the EU-15 was concerned that the accessing countries would bring considerable changes in the distribution of the budgetary expenditures, and mainly in the field of market measures, which might lead to overproduction in these countries, flooding western markets with their products.

Based on various studies, the following main *economic* expectations were expressed: advantageous changes would occur in productive assets and farm structure, plant production would have greater share in agricultural output, considerable modifications would be observed in the sector's subsidizing system and incomes, the foreign trade production turnover of agri-food economy and competitiveness would improve.

Having reviewed the bibliography on *social impact assessment*, it was expected that the income from agricultural activities could increase more markedly than the national average, motivating people to seek employment within the agricultural sector instead of other sectors, therefore the number of persons employed in agriculture was assumed to increase, and the quality parameters of those working in agriculture were also expected to improve. Regarding food consumption, mostly structural changes were anticipated.

Environmental impact assessments included among others the following main expectations: the state of natural resources would improve, the environmental load resulting from agriculture would reduce, the increased usage of renewable energy sources, including biomass, was expected, with which Hungary could fulfil its international undertakings in the fields of environment protection and energetics, and environmentally-sound farming was forecasted to gain ground among farmers.

The **main aim** of my dissertation is *to examine the complex effect of EU membership on Hungarian agriculture considering the three – economic, social and environmental – objectives described above.*

The realization of the above objectives is examined at *macro* (national) level, *ex-post* and *focusing on a medium term*.

I hope that this complex evaluation will contribute to the understanding of the complicated processes of the six years that have elapsed since Hungary's accession to the European Union.

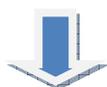
2: RESEARCH QUESTIONS, DATABASES AND METHODS

2.1. Questions examined

The questions examined in the frame of the dissertation and the related expectations are summarized in Table 1 (for the legends, see the following page).

Table 1: The major fields examined in the dissertation and the related expectations

Economic	Expecta-tion	Social	Expecta-tion	Environmental	Expecta-tion
1. Assets of production and farm structure		1. Employment		1. State of natural resources	↑
		1.1. quantitative parameters	↓		
		1.2. qualitative parameters	↑		
1.1. agric. land use	→	2. Change of relative income	↑	2. Environmental pollution from agriculture	↑
1.2. livestock	↓	3. Food consumption		3. Responses	
1.3. investment	↑	3.1. quantity	→	3.1. agri-environmental management	↑
1.4. farm structure	↑	3.2. structure	↑	3.2. organic farming	↑
2. Output	↑	3.3. price index	↑	3.3. cross-compliance	↑
3. Subsidy	↑			3.4. environmental investments	↑
4. Income	↑			4. Renewable energy	↑
5. Foreign trade balance and competitiveness					
5.1. foreign trade balance	↑				
5.2. competitiveness	↑				



THE FUNDAMENTAL QUESTION OF RESEARCH:
What major economic, social and environmental changes took place in Hungarian agriculture after the accession to the EU?

Source: Own construction

According to Table 1, the *expected directions* (increase/improvement, decrease/decline or stagnation) of *changes after the EU accession* anticipated by experts for the certain fields are marked with arrows, and the extents of changes are marked with yellow or red colours where red represents more considerable changes and yellow stands for less significant modifications.

(1) Research questions from economic aspects:

1. *Productive assets and farm structure*
 - 1.1. How has the size of agricultural land and the structure by land-use categories changed with regard to all of the farms and to each farm type?
 - 1.2. Has the decrease in livestock continued and which group of farmers was affected most adversely?
 - 1.3. How have agricultural investments changed?
 - 1.4. What changed took place in farm structure?
2. *How have the output and the structure of the agricultural sector changed?*
3. *What major changes occurred in the amount and structure of agricultural subsidies due to the introduced Common Agricultural Policy (CAP)?*
4. *How has the income changed in the agricultural sector?*
5. *Was Hungary able to profit from the opportunities provided by the common market for the foreign trade of food?*

(2) Research questions from social aspects:

1. *Has the decrease in agricultural employment continued and how has the quality parameters of agricultural employment changed?*
2. *What changes took place in the average income of persons employed in agriculture?*
3. *Has per capita food consumption increased and were there any changes observed in the structure of food consumption? How have food prices changed after the accession?*

(3) Research questions from environmental aspects:

1. *How has the state of natural resources changed?*
2. *What changes were observed in the environmental load from agriculture?*
3. *What responses have been made to mitigate environmental pollution caused by agriculture?*
4. *Has the objective to increase the usage of renewable energy been fulfilled?*

2.2. Databases used

Domestic data originated from the online database stADAT¹ of the Hungarian Central Statistical Office (HCSO), General Structure Surveys (2000), Farm Structure Surveys (2003, 2005, 2007), the Economic Accounts for Agriculture, the Farm Accountancy Data Network (FADN) operated by the Research Institute of Agricultural Economics, while international data were derived from the online database of Eurostat.

The data used for the evaluation of the foreign trade performance and competitiveness of Hungarian agri-food economy originated from the ComEXT² database, in accordance with the 2-digit SITC system, involving the product groups 0 (food) and 1 (beverages and tobacco).

For the assessment of environmental issues, domestic data were obtained from the database stADAT and the indices of Social Progress provided by HCSO, the strongly related database of the Ministry of Environment and Water, as well as their annual publications, while international sources included the online database of Eurostat, its regularly issued publications and evaluations, and certain books and country reports of OECD.

2.3. Methods applied

In the dissertation, a *comparative examination based on the analysis of time series was performed*.

On the basis of the available databases, the assessment was divided into two time intervals: the first interval included the period from 1998 to 2003, while the second one incorporated the years from 2004 to 2009 (in certain subchapters the time interval may differ from this depending on the database; however, such differences are expressly indicated in the dissertation).

In addition to presenting the annual data obtained by simple statistical methods (calculation of the ratio of distribution and indices) in bar charts, six-year averages (line chart) were also calculated for the given periods. The answers to the research questions were provided by the difference between the two charts, also indicating whether the expectations were met or not.

The method of averaging was chosen because of the annual fluctuations in the data of medium-range periods. However, in the case of some of the indices, there might be a marked

¹ The database can be accessed at the website:
http://portal.ksh.hu/portal/page?_pageid=37,592051&_dad=portal&_schema=PORTAL

²The database can be accessed at the website: <http://epp.eurostat.ec.europa.eu/newxtweb/>

tendency (increase or decrease) even within the medium-range term, making the assessment more difficult. To avoid this, three-year averages are used.

Methods applied for economic aspects:

When the changes in *agricultural incomes* were evaluated, indices ‘A’ and ‘C’ often used in international special literature, as well as certain *profitability and liquidity indices* were applied.

In the analysis of *competitiveness*, the various approaches of competitiveness, the measurement methods and the calculation of multifactor productivity are also presented.

The *competitiveness of foreign trade* can be examined by various methods applying competitiveness reports, econometric models or competitiveness indicators. Several indicators – *trade intensity index, Herfindahl index and simple RCA index* – were used simultaneously to analyse the competitiveness of the foreign trade of Hungarian agri-food economy in the markets of the EU-15 and the Visegrád Group; then the relation between the multifactor productivity of agriculture and the export performance of agri-food economy was examined using a multilaterally consistent Törnquist-Theil index.

Methods applied for social aspects:

The changes occurring in *agricultural employment* were assessed from the aspects of *quantitative and qualitative factors*, followed by the examination of gross average earnings. Finally, the modifications in food consumption are studied.

In terms of *quantitative* issues, the changes in the number and rate of employees or the persons employed in the sector are analyzed, and the problem of agricultural labour input is discussed, namely that the characteristics of labour input greatly varies between agricultural enterprises and individual/private farms, due to which the term annual working unit (AWU) had to be introduced in order to make the labour needs of these two groups comparable.

With regard to *qualitative* aspects, the age structure of private farmers (the process of senescence) and their educational level are examined.

The measurement of *food consumption* is based on consumption data calculated from food balances. Per capita food consumption can be calculated from these balances and expressed in

kilograms. In addition, per capita nutrient consumption is compared to the amount of recommended intake, and then the changes in the consumer price indices of food are studied as one of the factors determining the alteration in food consumption.

Methods applied for environmental aspects:

From the wide range of *environmental indicators* in the renewed Sustainable Development Strategy (SDS) of the European Union, the analysis was limited to those *indicators* relating to *agricultural activities*, which was further assisted by the *indices of Social Progress provided by HCSO*. The evaluation of the conditions before and after the accession on the basis of the available databases was in some cases obstructed by the lack of such databases.

The applied environmental indicators were grouped for the examinations as follows:

- *natural resources* (irrigation, area of forests, logging, defoliation, standing timber, biodiversity);
- *environmental load from agriculture* (agrochemicals, nitrogen surplus, emissions of greenhouse gases and acidifying substances, air pollution, climate change);
- *responses* (agri-environmental protection, organic farming, cross-compliance, environmental investments);
- *renewable energy* (biofuels share, share of renewable energy sources in the production of electricity)

3. RESULTS AND MAJOR CONCLUSIONS OF THE DISSERTATION

In the present work, the situation of Hungarian agriculture – from economic, social and environmental aspects – was analysed in the context of the EU accession.

The answer to whether the major expectations outlined in Chapter 1 were fulfilled is provided by the difference between the averages of the years 1998-2003 and those of 2004-2009. In the event the assessment involved time intervals other than these, this is expressly stated. A green check mark indicates the fulfilment of the given expectation, while a red x was placed if the expectation was not met.

3.1. Results relating to economic expectations

Table 2: Major results relating to economic expectations

Economic aspect	Expectation	Results	Realisation
1. Assets of production and farm structure			
1.1. agricultural land use*	→	-2.6%	X
1.2. livestock	↓	cattle: -12.2% pig: -26.5% sheep: +19.7% chicken, hen, cock: -1.6%	✓
1.3. investment (99-03, 04-08)	↑	-18.4%	X
1.4. farm structure (2007/2003 average arable land)	↑	Private farms: +16.0% Agricultural companies and partnership: +3.0%	✓
2. Output	↑	+8.4%	✓
3. Subsidy	↑	+131.7%	✓
4. Income	↑	+26.5%	✓
5. Foreign trade balance and competitiveness			
5.1. foreign trade balance	↑	balance: -9.4%	X
5.2. competitiveness	↑	decreased	X

Source: Own construction

*rate of agricultural cultivated land from the total area

In general, the size of agricultural cultivated land has minimally decreased, although there are differences between the land use categories and the types of farming: the greatest decline was found for vineyards with a 19.3% reduction, and the land usage of private farms decreased to a greater extent after the accession than that of agricultural enterprises in every land use category.

The decrease in *livestock* has continued, however, the increase in the number of sheep and the slowing down of the previous rapid decrease in the number of chickens, hens and roosters can be mentioned as positive factors. Regarding the farm structures of animal husbandry, *private farmers – primarily pig and poultry farmers - became the greatest losers of the accession.*

In accordance with data from the Economic Accounts for Agriculture, *the value of agricultural investments* after 2003, calculated at constant prices, did not reach the level of the years preceding the accession. The net value of investments per hectare of agricultural area for all the farms included in the Farm Accountancy Data Network was HUF 20 060 in 2003, which lessened to HUF 1 100 by 2005, whereas in 2007, the depletion of assets could be observed. In the following two years, the net value of investment increased again; however, in the case of private farms, the continuous depletion of assets only ceased in 2009.

As for *farm structure*, the data from the Farm Structure Survey clearly revealed that the number of farms below 50 ha has decreased after the EU accession, and the number of private farms reduced to a much greater extent than the number of agricultural enterprises, while the average farm size increased in the case of both agricultural enterprises and private farmers.

The *structure of activities* in *private farms* has scarcely changed between 2000 and 2007, the shift towards plant production, though to a lesser extent, took place after 2003. This inflexibility can be attributed to the special farming aims of private farms which is different from those of agricultural enterprises (over half of the private farms produce for own consumption only).

Table 3: Number of agricultural enterprises and the average size of their arable lands

	2003	2005	2007	2007/2003, %
Number of enterprises, thousand				
Agricultural companies and partnership	7.8	7.9	7.4	94.9
Private farms	765.6	706.9	618.7	80.8
Total	773.4	714.8	626.1	81.0
Average size of arable land, ha				
Agricultural companies and partnership	384.9	384.8	396.6	103.0
Private farms	4.4	4.2	5.1	116.0

Source: Farm Structure Survey 2007 1.1.; Laczka, 2007; EC, 2009b

Table 3 shows that, according to Structural Surveys, the number of private farms has fallen to a greater extent in 2007 compared to 2003, or nearly 20% during the years examined. In the case of agricultural enterprises, this magnitude and pace of decline can not be spoken, their number declined with only 400 units compared to 2003.

One of the consequences of the introduction of Common Agricultural Policy was that the *output* of Hungarian agriculture shifted towards plant production (the rate of which was 60% in 2009).



Figure 1: Share of main sectors in agricultural output, %

Source: Own structure based on Eurostat 2010f

The volume of output – decisively due to weather conditions – highly fluctuated in the examined years. A basically increasing tendency – fluctuating by years – can be observed for plant production, while animal husbandry shows a declining trend. In spite of the opposite changes in the two main sectors, a slight increase (+8.4%) was found, besides significant fluctuations, in the overall output.

The amount of *agricultural subsidies* increased to more than a double after the accession and their structure has considerably changed as well. Co-financing programs were introduced as a completely new form of support with conditions stricter than before, while the role and scope of former national subsidies has significantly decreased.

Agricultural incomes have increased post-accession in conformity with expectations, in which the growth of subsidies played a great role. In accordance with the data from the Farm Accountancy Data Network, the profitability indices of agricultural enterprises and private farms changed to almost the same extent, with the exception of profitability proportional to the production value.

Analysing the *competitiveness of the foreign trade of Hungarian agri-food economy*, one of the basic questions of foreign trade theories, is the definition and measurability of competitiveness and their determining factors. In the dissertation, the various interpretations provided by different disciplines for the term competitiveness are reviewed in detail.

The *competitiveness of foreign trade* can be examined by various methods applying competitiveness reports, econometric models or competitiveness indicators. Several indicators – *trade intensity index, Herfindahl index and simple RCA index* – were used simultaneously to analyse the competitiveness of the foreign trade of the Hungarian agri-food economy in the markets of the EU-15 and the Visegrád Group; then the relation between the multifactor productivity of agriculture and the export performance of the agri-food economy was examined using a multilaterally consistent Törnquist-Theil index.

Table 4: Revealed comparative advantages of Hungary in the EU-15 markets

Product groups	2003	2004	2005	2006	2007	2008	2009
Live animals (00)	1.89	0.83	0.62	0.35	0.63	1.14	0.98
Meat and meat preparations (01)	2.35	1.55	1.03	1.05	1.17	0.92	0.76
Dairy products and birds' eggs (02)	0.60	-0.05	-0.36	-0.43	-0.41	-0.23	-0.25
Fish (not marine mammals) crustaceans, molluscs and aquatic invertebrates (03)	-1.37	-1.82	-1.23	-2.02	-2.88	-3.33	-3.07
Cereals and cereal preparations (04)	1.49	0.98	1.07	1.33	1.75	1.59	1.41
Vegetables and fruit (05)	0.78	0.62	0.33	0.42	0.34	0.44	0.41
Sugars, sugar preparations and honey (06)	1.11	0.90	0.87	0.79	0.52	-0.03	0.27
Coffee, tea, cocoa, spices (07)	-0.39	-0.46	-0.55	-0.45	-0.47	-0.51	-0.64
Feeding stuff for animals (not including unmilled cereals) (08)	-0.02	0.13	0.28	0.14	-0.06	0.02	0.20
Miscellaneous edible products and preparations (09)	-0.70	-0.28	-0.62	-0.54	-0.27	-0.37	-0.46
Beverages (11)	0.55	-0.11	-0.31	-0.19	-0.18	-0.07	-0.15
Tobacco and tobacco manufactures (12)	-1.10	-0.79	0.61	-1.11	-1.20	-1.43	-2.88

Source: Own calculation based on Comext database

As can be seen from the data in Table 4, significant changes occurred in Hungary's revealed comparative advantage (RCA) indices in the agri-food foreign trade with the EU-15. In general, it can be stated that the values of the comparative advantage index decreased after 2003, and that there were high variance in the values between the product groups.

Our competitiveness decreased during the examined time period in nearly all of the 12 product groups. From the product groups that are decisive in terms of foreign trade (01, 02, 04, 05, 11), it was only the group of *cereals and cereal preparations* whose position could be improved as of 2005. It should be noted however that in 2009, we still had a comparative advantage in as many as three of these five product groups in the markets of the EU-15, while a comparative disadvantage was only found for the group of beverages.

As compared to the *Visegrád Group*, our competitiveness decreased noticeably, although to a different extent by the countries (see Annex 1).

Our revealed comparative advantage decreased in 8 of 11 product groups compared to Poland and the Czech Republic, and in 8 of 12 product groups when the comparison was made to Slovakia. In terms of agro-food external trade, our position is the worst in comparison to Poland, as there were only two product groups (05 and 08) in 2009 where we had a comparative advantage. Despite the unfavourable processes experienced after the accession to the EU, we still have comparative advantage in 6 product groups over the Czech Republic and in 8 product groups over Slovakia.

In the dissertation, the relation between *agricultural productivity* and *agri-food export performance* in the Visegrád Group was examined using Törnquist-Theil index. Agri-food export was enhanced in all of the countries post-accession. Between 2001 and 2009, agri-food export increased to the greatest extent in Poland, while Hungary had the least rate of increase, indicating that our country lost position against the Visegrád Group.

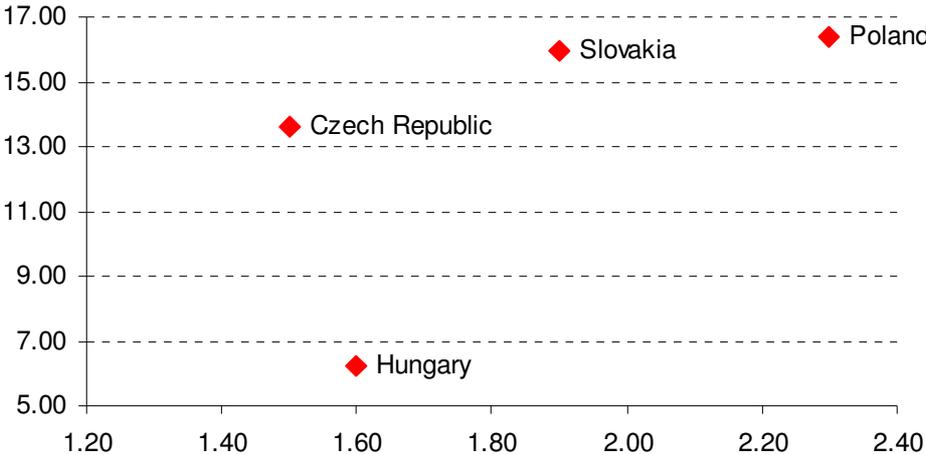


Figure 2: Annual average increase rates of multifactor productivity (x axis) and agri-food export performance (y axis) in the Visegrád Group between 2001 and 2009, %
 Source: Own calculation based on Comext database

The increase rate of multifactor productivity in the examined period was the highest in Poland, while Hungary could exceed only the Czech Republic. It is presumed that the agricultural export performance of the examined countries depended also on the differences in the average annual increase rate of agricultural productivity.

3.2. Results relating to social expectations

Table 5: Major results relating to social expectations

Social aspect	Expectation	Results	Realization
1. Employment			
1.1. quantitative parameters (average number of persons employed)	↓	-25.4%	✓
1.2. qualitative parameters (private farmers)	↑	Age: the rate of persons under 34 decreased to 7.2%	X
	→	Educational level: practice remained prevalent	✓
2. Relative income	↑	Gross average earnings: backwardness has reduced	✓
3. Food consumption			
3.1. quantity (99-03, 04-08)	→	+1.5%	X
3.2. structure	↑	No significant changes	X
3.3. price index	↑	-0.87%	X

Source: Own calculation

The changes in *agricultural employment* were examined on the basis of quantitative and qualitative aspects.

In terms of *quantitative* issues, the changes in the number and rate of employees or the persons employed in the sector have been analyzed. The problem of agricultural labour input is discussed, namely that the characteristics of labour input greatly varies between agricultural enterprises and private farms, due to which the term annual working unit (AWU) had to be introduced in order to make the labour needs of these two groups comparable.

On the basis of the examinations made, it can be established that the employment possibilities provided by agriculture reduced after the accession to the EU, whether the number of persons employed in agriculture (215.2 thousand in 2003, 175.8 thousand in 2009) or AWU or the number of employees is used to calculate labour input.

Table 6: Changes in the quantity parameters of agricultural employment in Hungary

Employed persons			
	1998-2003		2004-2009
Number of persons, thousand	250.9		187.1
Annual average rate of decrease, %	-4.8		-3.0
Agricultural working unit (AWU)			
	Non-salaried	Salaried	Total
2003, %	78.7	21.3	100.0
2009, %	74.7	25.3	100.0
Annual average rate of decrease (98-03), %	-4.6	-5.4	-4.8
Annual average rate of decrease (04-09), %	-5.1	-2.6	-4.5

Source: Own calculation based on stADAT 4.1.3. of HCSO

The annual average rate of decrease in the number of persons employed in agriculture calculated as the average of the six years which have elapsed since accession has reduced (-3.0%) as compared to the average of the years 1998-2003 (-4.8%).

While the rate of decrease in the number of salaried labour force has lowered, the labour input in non-salaried private farms declined even more than previously. All these results clearly demonstrate that the less favourable economic performance of private farms is also manifested in a relatively more unfavourable maintenance ability.

By 2009, agricultural labour input increased to some extent as compared to the preceding years, where non-salaried labour input grew by 1.6%. This slight increase can be explained by those who lost their jobs because of the economic crisis returning to agricultural activity for own consumption as their primary source of income. Total labour input decreased by 24% in comparison to 2003, which can be mainly attributed to the rapid decline in the number of private farms post-EU accession.

The *qualitative changes* in agricultural employment concerned age structure and educational levels.

No considerable change was found in the breakdown of private farmers by age. Compared to 2003, the greatest difference can be observed in the case of middle-aged and older persons: the rate of persons aged 45-54 and aged 54-64 decreased by 4 percent by 2007. It can be mentioned as a negative indicator that the rate of persons aged 34 decreased from 9.1% to 7.2%, indicating that agricultural activity is still not an attractive means of living.

No significant modification has been observed since 2003 in the educational level of private farmers either. Only 2% of farmers had higher education degrees and about 6% were qualified at secondary education level. Most private farmers rely exclusively on their own practical experience when performing agricultural work.

Mobility is limited mainly to young and well-educated persons, as they are less bonded psychologically to the sector. Middle-aged persons (without qualification and other utilizable expertise) have less opportunity to find a job outside of the sector.

Many expected that the situation of those earning their livings from agriculture would improve after EU accession, due to the increasing level of subsidies, income and several programs.

The *gross average income* of full-time employees in agriculture (HUF 137,101.00 in 2009) is, in spite of the increased level of subsidies, more than 30% less (31.3%) than the national average. *The gap between the agricultural gross average income and the national average reduced in the period 2004-2009, as compared to the average of the previous six years.*

There has been minimal improvement in the *quantity* of food consumption: the total amount of food consumption per capita was only 1.5% higher after the accession than the average of the years 1999-2003, which confirmed the expectation that food consumption would or would not change slightly following accession.

No considerable alteration was found in the structure of food consumption either, and even though there are fluctuations between the years, these are consistent with the agricultural output of the given year. The consumption of two food groups (fruits and vegetables, milk and milk products) important from the aspect of a healthy diet has increased.

The *rocketing of the consumer price index of food* was expected to be one of the disadvantageous consequences of the accession to the European Union. For this reason, this issue and the underlying factors were also examined in the dissertation. The *anticipated sudden increase in food prices did not take place*. The cheap import goods brought into the country in large quantities restrained the increase of food consumer prices, which contributed to the suppression of inflation and the stabilization of food consumption. However, *food prices considerably increased in 2006-2008*, at a rate exceeding the average consumer price increase, which facilitated the increase of inflation. As demonstrated by the data in Table 5,

the increase in food prices was somewhat slower during the six years that elapsed since Hungary's accession than in the previous six years.

3.3. Results relating to environmental expectations

Table 7: Major results relating to environmental expectations

Environmental aspect	Expecta-tion	Results	Realization
1. State of natural resources			
1.1. irrigated area (99-03, 04-08)	↑	-18.2%	X
1.2. area of forests (04-09)	↑	+7.0%	✓
1.3. biological diversity (bird population 99-03, 04-08; protected areas, 2006)	↑	Bird population: +2.2%* Protected areas: 85%**	✓
2. Environmental pollution from agriculture			
2.1. artificial fertilizers	↑	+13.3%	✓
2.2. manure (99-03, 04-08, agricultural enterprises)	↑	+5.3%	✓
2.3. pesticides (02-08)	↑	+27.7%	✓
2.4. emission of greenhouse gases (00-03 and 04-08)	↑	-3.2%	✓
3. Responses			
3.1. environmentally friendly management (amount of subsidy 08/04)	↑	+541.3%	✓
3.2. organic farming	↑	area: +84.0% number of producers: +91.6%	✓
3.3. cross-compliance	↑	5 directives***	✓
3.4. environmental investments (01-03 and 04-09)	↑	+453.0%	✓
4. Renewable energy			
4.1. renewable energy (share in the production of electricity in 2006)	↑	4.7%	✓
4.2. biofuels share (goal for 2010)	↑	5.75%	✓

Source: Own calculation

* population of farmland birds

** rate of protected area in 2006 from the areas deserving protection

*** 5 of 19 directives are connected to environmental protection

Considering *natural resources*, the expectations in connection with the area of forests and biological diversity were fulfilled. Favourable change can be observed in the case of forests, which is mainly attributable to afforestation. In addition, the state of forest health has also improved: defoliation reduced and the rate of symptom-free forests increased. Hungary joined the international convention on the preservation of biodiversity and the establishment of Natura 2000 network. This latter is based on two EU directives, the *directive on the conservation of wild birds* and the *habitats directive*. Minimal improvement was found in the population of farmland birds, while significant reduction occurred in the size of irrigated area.

To assess *environmental pollution caused by agriculture*, first the changes in the usage of fertilizers, pesticides and manure was examined, then the emissions of greenhouse gases and of acidifying substances by agricultural activities were analysed.

Table 8: Changes in environmental pollution resulting from agriculture in Hungary

Designation	Average of 1998-2003				Average of 2004-2009			
	Fertilizers supply (in active ingredient)							
Total amount, thousand tons	383.3				434.3			
Amount of fertilizers per hectare of agricultural area in active ingredient, kg/ha	64.8				74.5			
	Manure (average of 99-03 and 04-08)							
Amount used, thousand tons, (agricultural enterprises)	3619.2				3811.4			
	Sales of pesticides							
Amount sold, tons	2002	2003	2004	2005	2006	2007	2008	
	16463	14915	19881	19352	23046	22356	24168	

Source: stADAT 4.1.5 of HCSO; HCSO 2005a, 2006b, 2008b, 2009b, 2010b, 2010j; Ministry of Agriculture and Rural Development (FVM) 2005, 2007, 2008a, 2010b

Considering the field examined first, it can be stated that environmental load from pesticide usage has intensified. Despite the slight increase in the amount of fertilizers, *the nitrogen balance showed a favourable tendency*. The efficiency of fertilizer supply, for instance, has clearly improved, as can be seen from the comparison of data relating to gross output of unit plant production. Due to the elimination of liquid dung pig farms and the decline of this technology, environmental load from agriculture has greatly reduced.

As for the other examined area, the *emissions of greenhouse gases and of ozone precursors have reduced (by 3.2 and 9.4%, respectively), while the emission of acidifying substances have increased by 8%*, when the average of the years 2000-2003 is compared to that of 2004-2008.

The research question relating to the responses was: what other activities can Hungarian farmers perform to improve the environmental state of agricultural fields. In the period after the accession, the measures to encourage the environmental awareness and the sense of responsibility of farmers have multiplied in the fields of both the enforcement by *legal instruments* (cross-compliance) and *economic incentives (subsidies)*. The effects of these measures have also become clearly visible such as in the significant growth in environmental investments, the expansion of agri-environmental programs, the strengthening of organic farming, etc, facilitating the environmental awareness and the sense of responsibility of farmers in comparison to the period before the accession.

In terms of *energy supply*, answers to two main questions were attempted; the first being the fulfilment of the requirement on the minimum share of biofuels in petrol and diesel oil usage calculated as energy content; the second including the share of renewable energy sources in the production of electricity.

For Hungarian agriculture, the production of biofuels may, on the one hand, provide an opportunity to diversify the agricultural activity. On the other hand, this activity raises environmental and social issues, as well. Environmental concerns include the deterioration of soil fertility, the effects on the accessibility and quality of water resources, while the competition between biofuels and food production is mentioned as a social concern.

At the time of the accession, Hungary undertook to increase *the share of renewable energy sources in the production of electricity* to 3.6% by 2010. As can be seen from Table 7, this *rate was exceeded*. To be able to realize the target, the application of renewable energy sources had to be increased significantly, in which an advantageous process can be observed. In 2000, Hungary applied only three types of renewable energy sources in the production of electricity and the rate of biomass was the dominant factor (74%) by 2008. In the application of renewable energy sources, Hungary was able to take steps which contributed to the expansion of the domestic energy mix and the improvement of the quality of the environment. *The requirement on the share of biofuels specified by the EU was also fulfilled.*

Summary

Two aspects learned from Table 2, 5, and 7 should be reviewed.

The expectations were fulfilled in the largest proportion in the area of the environment (92.3%), to a much less extent in the economy (55.6%) and least of all in the social domain (42.9%).

As concerns Hungary's accession to the EU, the results are positive in respect to the environment (76.9%), while negative impacts (56.6% and 57.1%) were dominant both in the economic and social domains.

4. NEW AND NOVEL RESULTS

1. As far as I know, this is the first attempt in the special literature of Hungarian agricultural economics to analyze the *complex* (economic, social and environmental) *effects* of Hungary's EU accession on Hungarian agriculture.
2. Using various competitiveness indicators – the trade intensity index, the Herfindahl index and a simple RCA index – it was established that the competitiveness of the foreign trade of Hungarian agri-food economy in the markets of both the EU-15 and the Visegrád Group has decreased after the accession. From among the Visegrád Group, the revealed comparative advantage index of the country has reduced the most against Poland.
3. The Törnquist-Theil index was used to reveal that there might be a correlation between the annual average increase rate of multifactor productivity and the export performance of the agri-food economy, as concerns the Visegrád Group. The factors by which Poland could reach the highest result in the area of export performance of the agri-food economy in the examined countries were identified.
4. Analysing the *social effects* of Hungary's accession, it was found that the maintenance ability of agriculture further reduced. However, the rate of decline has decreased post-accession and the gap between the agricultural gross average income per capita and the national average also reduced slightly. It was demonstrated that farmers, after initial difficulties, have increasingly adapted to the changes in regulation and in the institutional system: they have learnt how to benefit from the opportunities provided by applications.
5. Applying the *environmental indicators* relating to agricultural activities and included in the renewed Sustainable Development Strategy of the European Union, it was shown that the positive effect of EU accession is the most distinct in the field of agricultural environment protection. Significant advancement was found in the field of measures aiming to preserve biodiversity. The requirements and measures included in Common Agricultural Policy have contributed to the conservation of the state of natural resources, the reduction in environmental pollution caused by agricultural activities, the spreading of environmentally friendly farming practices, and the increase in the importance of renewable energy sources produced by agriculture.
6. Finally, the comprehensive verification of the fact that *private farmers faced more challenges after Hungary's accession than agricultural enterprises, both in terms of*

economic and social aspects, is considered as an important new research result. In addition to the fact that the agricultural policy of the EU apparently supports this process, the nature of these challenges can be explained by Hungary's export-oriented agricultural policy of the latest years, which was conducted without taking into account the employment issues of the rural areas enough.

5. PRACTICAL APPLICABILITY OF THE DISSERTATION

The results of this thesis can be applied in practice in *several fields*.

For *political decision makers and their consultants*, mainly within the Ministry of Rural Development, the results in connection with the economic, social and environmental expectations provide several conclusions.

The *Hungarian Chamber of Agriculture and the leaders of agricultural interest groups* can also benefit from the useful results of the analyses.

For *researchers dealing with the consequences of EU integration*, the complex approach of the subject may supply new information.

In addition to the above, the research results and methods, as well as the wide range of domestic and foreign information sources studied in the dissertation can be utilized *in both gradual and post-gradual education*.

Finally, it is assumed that the thesis may arouse the interest of *foreign experts and PhD students*, as well.

Annex 1: Revealed Comparative Advantage (RCA) of Hungary to Visegrád Group

	2003	2004	2005	2006	2007	2008	2009
Czech Republic							
Live animals (00)	-2,19	-4,23	-3,87	-1,03	-1,00	-0,44	-1,35
Meat and meat preparations (01)	3,55	2,35	1,28	1,38	0,95	0,62	0,28
Dairy products and birds' eggs (02)	-0,09	-0,81	-0,89	-0,57	-1,27	-1,50	-1,82
Fish (not marine mammals) crustaceans, molluscs and aquatic invertebrates (03)	-1,08	-2,44	-4,19	-4,61	-2,82	-3,39	-4,79
Cereals and cereal preparations (04)	-0,86	-1,12	-0,65	-0,02	0,26	0,19	0,18
Vegetables and fruit (05)	1,14	0,32	-0,35	0,34	0,16	-0,36	-0,18
Sugars, sugar preparations and honey (06)	-0,75	-1,94	-0,37	0,45	0,81	1,36	1,45
Coffee, tea, cocoa, spices (07)	0,44	0,24	0,37	0,90	0,54	0,36	0,14
Feeding stuff for animals (not including unmilled cereals) (08)	1,99	1,19	1,66	1,68	0,84	0,12	1,42
Miscellaneous edible products and preparations (09)	0,07	-0,28	-0,35	-0,53	-0,78	-0,99	-0,86
Beverages (11)	0,99	-0,13	-0,10	-0,12	0,02	0,57	0,42
Tobacco and tobacco manufactures (12)	n.a	0,27	3,56	9,09	n.a	3,77	-3,94
Poland							
Live animals (00)	0,25	-0,37	-2,03	-4,46	-2,84	-2,37	-1,80
Meat and meat preparations (01)	1,83	0,07	-0,82	-0,78	-0,10	-0,48	-0,61
Dairy products and birds' eggs (02)	-0,57	-2,31	-2,50	-1,90	-1,25	-1,93	-2,14
Fish (not marine mammals) crustaceans, molluscs and aquatic invertebrates (03)	-2,06	-2,39	-3,70	-3,27	-3,11	n.a.	-7,21
Cereals and cereal preparations (04)	-0,62	-0,86	-1,83	-0,71	0,23	0,61	-0,62
Vegetables and fruit (05)	0,87	0,46	0,17	0,00	0,41	0,32	0,33
Sugars, sugar preparations and honey (06)	-1,55	-0,81	-0,98	-0,20	-0,41	-0,92	-0,77
Coffee, tea, cocoa, spices (07)	-0,41	0,02	-0,09	-0,15	-0,12	-0,31	-0,82
Feeding stuff for animals (not including unmilled cereals) (08)	1,02	1,91	1,29	0,28	0,18	0,99	1,12
Miscellaneous edible products and preparations (09)	-0,83	-0,30	-1,37	-1,34	-0,96	-1,25	-1,31
Beverages (11)	0,51	-0,75	-1,50	-0,79	-0,61	-0,35	-1,08
Tobacco and tobacco manufactures (12)	n.a	-1,08	6,36	-2,82	-4,77	-8,25	-7,72
Slovakia							
Live animals (00)	-0,04	-2,37	-1,59	-1,92	-3,40	-0,42	-0,35
Meat and meat preparations (01)	4,29	0,68	-0,85	-0,32	-0,23	0,22	0,40
Dairy products and birds' eggs (02)	-1,49	-2,30	-1,56	-1,71	-1,53	-0,87	-1,26
Fish (not marine mammals) crustaceans, molluscs and aquatic invertebrates (03)	-2,18	-4,76	-4,63	-4,23	-5,65	-3,53	-2,45
Cereals and cereal preparations (04)	-0,88	-0,97	-1,21	-0,02	0,07	1,42	0,52
Vegetables and fruit (05)	0,85	1,01	1,08	0,39	0,08	0,12	0,36
Sugars, sugar preparations and honey (06)	-1,02	-1,21	1,04	1,46	1,37	0,94	0,79
Coffee, tea, cocoa, spices (07)	1,50	-0,10	-0,03	0,33	0,84	1,11	0,19
Feeding stuff for animals (not including unmilled cereals) (08)	0,84	0,31	0,70	-0,24	-0,20	0,14	0,06
Miscellaneous edible products and preparations (09)	-1,54	-0,76	-0,51	-0,60	-0,45	-0,22	-0,52
Beverages (11)	0,44	0,28	1,08	2,27	3,15	3,28	2,53
Tobacco and tobacco manufactures (12)	2,72	0,51	n.a.	n.a.	0,96	-3,20	1,53

Source: Own calculation based on Comext database

6. PUBLICATIONS IN THE SUBJECT OF THE DISSERTATION

Scientific journal in foreign language

Baráth Lajos – **Nagy Zsuzsanna** – Szabó Gábor (2010): The correlation between the agricultural productivity and the export performance of the agri-food foreign trade in the Visegrad group countries following accession to the European Union. *Studies in Agricultural Economics*, 2010. No. 112. 55-68.

Hungarian scientific journals with abstracts in foreign language

Nagy Zsuzsanna (2006): A második pillér erősödése az Európai Unióban a KAP reformokat követően. *Agrártudományi Közlemények*, 2006/20. Különszám, 88-94.

Nagy Zsuzsanna (2008): A magyar külkereskedelem a rendszerváltozást követően. *Agrártudományi Közlemények*, 2008/29. 145-154.

Nagy Zsuzsanna (2009): A magyar élelmiszer-gazdaság aggregált szintű külkereskedelmi teljesítménye az EU-csatlakozást követően. *Gazdálkodás*, 2009. 53. évf., 6. sz. 562-571.

Conference presentations published abroad in full in foreign language

Nagy Zsuzsanna (2006): The rural development policy in the European Union and in Hungary. The 1st International Conference on Agriculture and Rural Development. Topusko, Croatia, 2006. 23-25 November. (CD melléklet, 6 o.)

Nagy Zsuzsanna – Baráth Lajos (2007): The main changes in Hungarian external trade after 2004. “European trends in the Development of Agriculture and rural Areas” XVI. Agrarian Perspectives. Prague, The Czech Republic, 2007. 16-18 September. (CD melléklet, 8 o.)

Nagy Zsuzsanna (2009): Development of agri-food external trade and its concentration: case study of Hungary (1999-2007). IAMO Forum 2009. Halle, Germany, 2009. 17-19 June (CD melléklet, 16 o.)

Conference presentations published in Hungarian with abstracts in foreign language

Nagy Zsuzsanna (2008): A magyar agrár-külkereskedelem piaci szerkezetváltozása 2000-2006 között. 50. Jubileumi Georgikon Napok. Keszthely, 2008. szeptember 25-26. (CD melléklet, 7 o.)

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Conference presentations published in Hungarian without abstracts in foreign language

Baráth Lajos – **Nagy Zsuzsanna (2005):** A mezőgazdaság fejlődésének főbb tendenciái Magyarországon és a keletnémet tartományokban. 11. Ifjúsági Tudományos Fórum, Keszthely, 2005. március 24. (CD melléklet, 6 o.)

Baráth Lajos - **Nagy Zsuzsanna (2005):** A német mezőgazdaság fejlődésének főbb tendenciái, különös tekintettel a keletnémet tartományokra. AVA 2, Debrecen, 2005. április 7-8. (CD melléklet, 12 o.)

Baráth Lajos - **Nagy Zsuzsanna (2005):** A magyar és a keletnémet tartományok mezőgazdasági fejlődésének jellegzetességei a rendszerváltási utáni időszakban. „Verseny élesben”, Európa napi Nemzetközi konferencia, Mosonmagyaróvár, 2005. május 5-6. (CD melléklet 6 o.)

Nagy Zsuzsanna (2006): Az európai uniós belépés hatása a magyar mezőgazdaságra. X. Nemzetközi Agrárökonómiai Tudományos Napok, Gyöngyös, 2006. március 30-31. (CD melléklet, 9 o.)

Nagy Zsuzsanna (2007): A magyar agrár külkereskedelem versenyképességének alakulása az uniós csatlakozást követően. Merre tart a világgazdaság: Európa helyzete. BMGE Gazdálkodás és Társadalomtudományi Kar Műszaki Menedzsment Gazdálkodás és Szervezéstudományi Doktori Iskola. 31-42. Budapest, 2007. december 7.

Poster

Nagy Zsuzsanna (2007): Effects of accession to the EU on Hungarian agriculture. MACE Conference. Berlin, Germany. 17-18. 01. 2007