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PH.D. THESIS

ECONOMIC OPPORTUNITY AND CONDITION OF GROWTH OF THE ORGANIC AGRICULTURE IN THE EUROPEAN UNION

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1. INTRODUCTION

In the 1990s organic farming became popular worldwide, and this production method started to go on a way towards the mass production. The young intellectuals became enthusiastic consumers of organic products, and the “fashion” consumption created a premium price, – due to the disequilibrium between demand and supply – which stimulated the entrance of new producers. This seemed to be just a temporary state due to the restitution of the market equilibrium. The growth of the production and as a consequence of the supply the magnitude of the premium prices for organic products diminished significantly, according to experiences in other countries, which directly affected the competitiveness of this sector. As a consequence of this, in 2008 to state about organic farming that it is more and more popular among both producers and consumers is not acute. It is more accurate to say that organic farming became an integral part of agriculture. Its synonyms (biological, ecological) already known expressions, however, the consumers not always know what they mean exactly and how these types of products are produced. The latter would not be a big problem, - since we are also not familiar with the process of computer constructions, and we still can use them properly – but is a bigger problem that the consumers don’t know how to recognise the organic products in the shops. With the importance of this the marketing research is dealing, but we cannot pass along these facts without a word, when the main aim of this research to analyse the growth of organic farming, its economic conditions and opportunities in the European Union, with special emphasis on the possible future scenarios.
In order to achieve the main target of this research the following sub-targets were set:

- The historical overview of the formation and development of organic farming;
- The valuation of the current situation of organic farming worldwide, focusing on Europe and Hungary;
- Formulation of future perspectives (area, number of farms);
- Analysis of the relation between economic development and organic farming;
- Analysis of the production structure of organic farming.

In the above target framework the focus was on the proof of the following hypothesis:

- The growth of organic farming is slowing down and approaching a maximum value. The upper bound of these values is determined by organic product prices, in the case of full markets;
- The ban of the production of genetically modified crops gives competitive advantage for organic farming;
- There is a strong, positive correlation between ecological growth and organic farming.

During my research study I used the expression of organic farming and organic products, producers. I identified organic the type of production, which is determined organic by law, regardless that in everyday life somewhat more or less producers or area is called organic. For easier phrasing hereunder the conventional farming means all production methods that are not organic.

2. MATERIALS AND METHODS

2.1. Materials

During this research my task was to overview the national and international literature, organise it and make a critical analysis of it.

The overview of the scientific literature, as theoretical base, was followed by building a specific database. This database consists of secondary data, and I obtained this from the open - mainly electronic - database of the following organisations:

- IFOAM (International Federation of Organic Agricultural Movement);
- FiBL (Forschungsinstitut für biologischen Landbau, Research Institution of Organic Farming;
- SÖL (Stiftung Ökologie & Landbau, Organic and Agricultural Endowment)
- ITC (International Trade Center);
- ISAAA (International Service for the Acquisition of Agri-biotech Applications);
- EUROSTAT database;
- Biokontroll Hungária Nonprofit Kft.; (Biocontrol Hungarian Nonprofit Ltd.)
- Hungária Öko Garancia Kft. (Hungarian Organic Insurance Ltd.)

During my research I also worked with primary data. The primary, farm level data was obtained through deep interviews in the framework of an international research program (*Further Development of Organic Farming Policy in Europe, with Particular Emphasis on EU Enlargement,* The leader of this research project in Hungary was Dr. Kürthy Gyöngyi.*)*. The results of this research were published at national conferences, however they can be found on the homepage of the research program itself. Therefore – and also because not all the study areas are strongly connected to the topic of this thesis – I do not delineate the exact description of this project, only I refer to the most important conclusions.

2.2. Methods

Timeline analysis

I used timeline analysis to analyse the organically managed areas and the number of organic farmers through time.

In the course of the timeline-based predictions, the most popular function is the logistic function. The reason for this is that the developing processes observed in the nature mainly do not take a linear form. The first stage of many growing processes can be described by assuming an exponential change [MOLNÁR – CSAPÓ, 2003.]. However, „the trees do not grow until the sky", and the growth in constant pace is not sustainable neither in the nature nor on a farm. The process after some time reaches a state when the obstacles of growth have their impact and as a consequence of this the growth pace diminishes remarkably, heading towards 0. In this way the process can be described by a trend similar to a long-drawn S-curve [HUNYADI, 2004.].

First time the logistic growth was used in 1845 by a Belgian mathematician Verhulst. Later, more scientists went back to the use of the logistic function explaining the growth. For example, in 1909 a chemist Wilhelm Ostwald, who called it an autocatalytic model, or, in 1922 Pearl and Reed, who used the logistic function for modelling the population growth – slightly modified. [FOKASZ, 2006., PEARL – REED, 1922.]

The Johnson-Schumacher function is rising faster than the logistic function and it is not symmetric. Thus, for reaching the inflation point less time is needed than the time from the inflation point to the saturation point. This means that the fast growth is followed by a slower saturation. The Gompertz function rises the steepest, thus, this type of curve reaches the saturation point the most rapidly. [CZABÁN, 1990.]

Variants of the S-curves:

Verhulst-type logistic function:

$$y_t = \frac{k}{1 + a \cdot e^{-b \cdot t}}$$

or with reparametrisation based on Hunyadi:

(a = exp(β_0) és b = -β_1)

$$y_t = \frac{k}{1 + \exp(\beta_0 + \beta_1 \cdot t)}$$

Pearl-Reed function:

$$y_t = \frac{b}{e^{-a \cdot t} + c}$$

Gompertz function:

$$y_t = e^{\ln k - a \cdot e^{-t}}$$

Johnson – Schumacher function:

$$y_t = e^{k - \frac{a}{b+t}}$$

For my calculations the Verhulst-type logistic function was used, which I reparametrised based on Hunyadi, due to a better interpretation of the parameters. The parameters and the description of the Verhulst-type logistic function are the following:

- *k*: impregnation parameter (saturation level);
- ***β_0*: shifting parameter**, when everything is constant it shifts the curve to the right;
- *β_1*: ***shape parameter***, its growth makes the function steeper (in absolute value). [HUNYADI, 2004.]

Correlation- and regression analysis

In order to analyse, whether the size of the subsidies have an effect on the organic land area and the number of organic farms, and whether in the developed countries those are higher than in the developing ones, I made correlation- and regression analysis.
Correlation analysis helps us to answer what are the factors (explanatory variables) that influence a certain state (dependent variable), and each of these factors in which extent affect that state, how strong the relationship is between them. In the regression analyses we explain

the relationship by fitting a curve based on the known relation between dependent and explanatory variables.

Pareto-analysis

The aim with Pareto-analyses was to find those factors which have the strongest influence on the growth of the organic land area in Hungary. The Pareto-diagram makes it possible to analyse these factors and the Pareto-analyses puts it in order showing it in a column diagram.

The method was named after an Italian economist Vilfredo Pareto, who during the analysis of the Italian economy discovered that 80% of the country's economy is in the hands of only 20% of the population. With this he created the 80/20 rule, which is the key of the Pareto-analysis.

BCG-matrix

In order to analyse the production structure a BCG-matrix was used. For the BCG-matrix the market growth between 2003 and 2006 was determined as an average growth during these years, and the market share was described by a simple proportion of the distribution of production in 2006.

Similar to the Pareto-analysis, here as well, I analysed separately the already converted and during conversion organic areas and products. However, they did not show significant differences, and there is no difference in the production process whether it is organic or in-conversion product.

Cluster analysis

Cluster analysis was used to sort the EU countries into different groups and to check the results got from BCG-matrix.

The cluster analysis is a method which groups the observed units in relatively homogenous groups, so called clusters.

From different clustering methods the use of the non-hierarchic method is the most expedient if the number of samples is high [SAJTOS – MITEV, 2007. 298. p.]. Since the number of the EU member states is low (n = 25) the hierarchic clustering method was chosen for clustering the countries, and based on Sajtos-Mitev (295.p.) the Ward-process.

In order to check the results of the BCG-matrix the K-centred cluster was chosen, because the number of clusters would be provided in advance.

The calculations were done by SPSS 15.0 statistical program and Excel.

3. RESULTS

The structure of the results chapter is the following:

- In non-European countries, the size and the land area used for organic production.
- In the EU-15 and EU-10 countries, analysis of the countries' production structure, focusing on the model results. The development of the premium prices through time, the role of the subsidies on the growth of the land area used for organic production, and the relation between the economic growth and the size of the total organic land area.
- Introduction of the Hungarian organic production, the synthesis of the results of this research.

3.1. Analysis of the growth of organic farming in Europe

The main aim of this research was to model the possible future scenarios. I developed three different model scenarios. These are the following:

1. scenario:
   using natural logarithm function, the saturation point was approximated by assuming 10% growth.
2. scenario:
   the value of the saturation level was determined by the targets of each country.
3. scenario:
   the effects of the GM crops were also considered. The saturation point was reduced by the expected size of the production area of GM crops and the isolation area. Since, the size of the land area for production and the size of the parcels are important for the calculation of the isolation area, two sub-scenarios were analysed, due to different parcel sizes in practice. In the first sub-scenario the calculation was made by assuming square parcels, and in the second one oblong parcels.

3.1.1. Analysis of the growth of organic farming by natural logarithmic function

In the first scenario 10% annual growth was assumed. Based on this, the saturation level was changed by the following parameter:

$$k = 1{,}1 y_{\max},$$

where

$y_{\max}$ = the biggest organic land area until time „t" (ha)

Thus, the function is:

$$y_t = \frac{1{,}1 y_{\max}}{1 + \exp(\beta_0 + \beta_1 \cdot t)}$$

In the case of each EU-15 country the square value of the correlation coefficient is close to one (table 1.), which means that the fitting of the function is good, despite of that the relative standard deviation of residuals is high.

In the case of Greece, Italy, Portugal, Spain and the UK, based on the value of the shifting parameter ***(β_0),*** we can say that organic farming started a rapid growth later compared to the other countries. The analysis of the shape parameter ***(β_1)*** shows that in Finland, Italy, Portugal and Spain was the most intensive the growth (the absolute values of the β_1 parameters are the highest), because in these countries the market opportunities and regulatory conditions were more favourable.

In case the EU-15 states – as common market – are analysed together (figure 1.), the fit of the logistic function can be described by the square of the correlation coefficient ***(r^2 = 0,99)*** and by the standard deviation of the residuals ***(V_{Se} = 5%).*** The results show that in Europe the growth of the organic land area is slowing down and is predicted to stagnate at a certain point. This level was assumed, in the first scenario, to be 5,8 million hectares at the level of the whole Europe. Based on the classical economic law the production does not grow due to the stagnation of the consumption. Thus, the following question arises: how will the Hungarian producers be able to prevail among in such a saturated market?

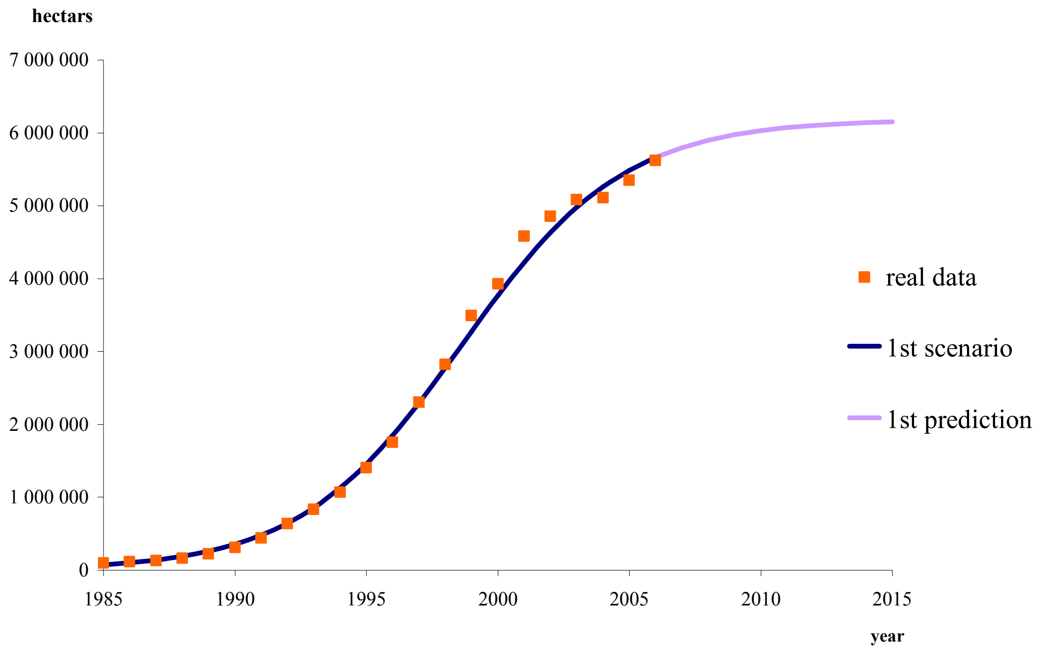

Figure 1. Size of organic land area in the EU-15 countries based on real data and model predictions from own calculations

Table 1. Results of the logistic function fit on the development of organic land area in the case of the EU-15 countries

Countries	**k**	**s_e**	**Vs_e**	**r^2**	**β_0**	**$-\beta_1$**
	'000 ha	**'000 ha**	**%**			
Austria	397	64	34	0,85	0,51	0,34
Belgium	27	2	24	0,93	1,17	0,34
Denmark	196	18	25	0,92	1,01	0,33
Finland	178	13	18	0,96	1,13	0,42
France	617	51	23	0,9	0,76	0,25
Germany	888	79	21	0,94	0,56	0,28
Greece	317	34	67	0,95	3,97	0,30
Ireland	39	4	22	0,93	0,69	0,31
Italy	1 353	147	32	0,93	1,75	0,44
Luxemburg	4	-	46	0,67	1	0,18
Netherlands	54	4	20	0,94	0,8	0,25
Portugal	257	15	36	0,98	3,37	0,46
Spain	888	34	15	0,96	2,61	0,46
Sweden	378	64	48	0,81	1,23	0,32
United Kingdom	797	72	30	0,91	1,72	0,38
EU-15	5 883	105	5	0,99	1,05	0,34

Source: own calculations

In the case when the land area data is corresponding with the supply data, we can say that the function matches the product life-cycle curve that is frequently used in marketing. In the case if we accept this statement, we can conclude that organic products do not have a special place among the consumables, and have the same life-cycle as any other product.

After analysing the organic land areas calculations of the numbers of organic farms were made. As already mentioned that „trees do not grow until the sky", the change through time was approached by a logistic function. The results are shown in Figure 2. The relative error of the fitted function is around 20%. The reason of this is that the number of farms did fall between 2001 and 2004 – or did not grow in a significant extent – and only in 2005 started to grow again. In the case of Austria, Greece, Italy, Sweden and UK the relative standard deviation of residuals is above 20%. In Austria the number of organic farms has not changed significantly since 1995. In Greece by 2005 the number of organic farms grew remarkably, compared to the previous years more than 6 thousands more farmers produced organically. In Italy from 56 thousand farmers approximately 20 thousand farmers stopped to practice organic farming between 2001 and 2004. In Sweden between 2001 and 2005 the number of farms fell from 5 thousand by 3 thousand. In UK between 1997 and 2001 the number of farms four folded but from 2001 the number of farms did not grew significantly.

The reason of the fall in the number of organic farms is that the demand for organic products has fallen due to the nitrophen-contamination on the market, and those who already had a secure market also had problem to sell their products. The problems with the realisation did not stimulate the conventional farmers to convert.

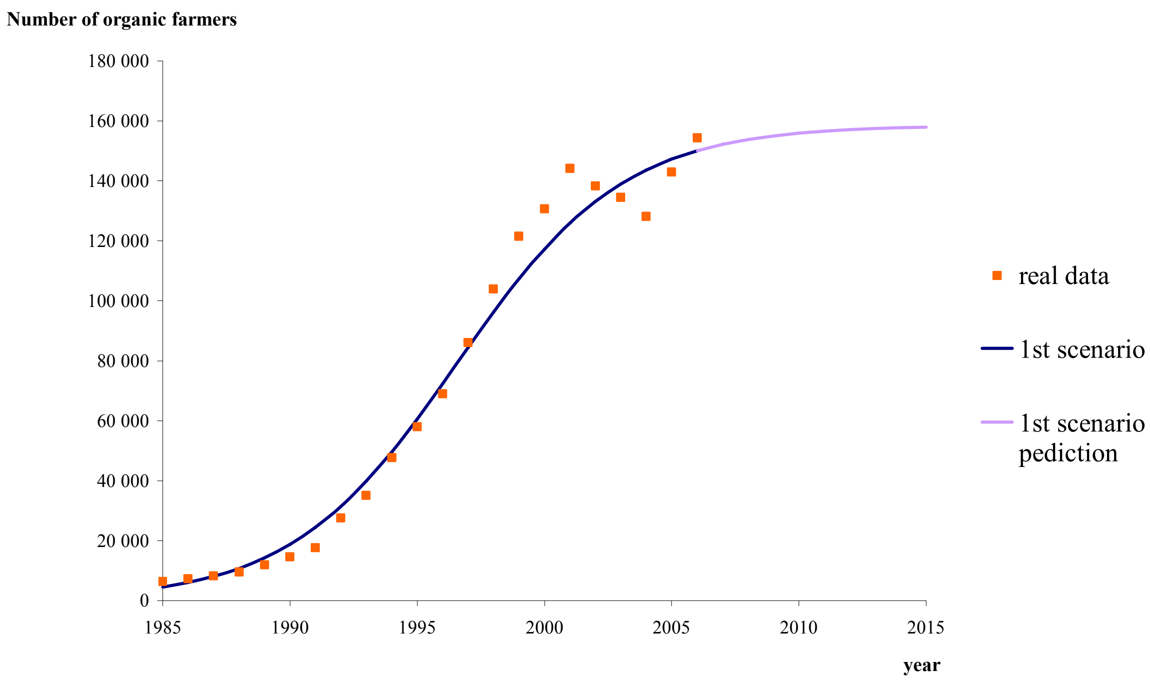

Figure 2. Number of organic farmers in the EU-15 countries based on real data and model predictions from own calculations

3.1.2. Analysis of growth of organic farming by natural logarithmic function, considering the targets of the countries

Since the different countries set the targets based on the proportion of the total agricultural land area, before the model description I start with an overview of the organic land area as a percentage of the total agricultural area in the EU-15 countries.

Analysing the organic land area in the last 12 years Austria, Finland (around 10%), Sweden, Denmark and Ireland are above the average of the EU-15 countries, thus in these countries organic farming has great importance.
Based on the second scenario the maximum of the growth, the saturation level, is the value determined in each countries action plan.

However, not all the countries have exact targets in the proportion of the land area. Therefore, during my calculations, for the countries that do not have these targets, two different percentages were assumed. 10% was assumed for those where the proportion of the organic land area was between 5% and 10%, and 5% where it was below 5% in 2006.

In Luxembourg the size of the organic area is very small; therefore, it was not included in further analyses.

In principal, the development of organic farming is supported by all the countries, which means that most of them have strategic plans for its development. The fact that in 2006 the EU has accepted the action plan about organic farming and food consumption might also help to contribute to the growth of the organic land area.

Based on this the saturation level has changed according to the following:

$$k = x_t \cdot \lambda$$

where

x_t = the size of the agricultural land area in 2010 (ha)
λ = the target set by each country for organic land area in a proportion of the total agricultural land area

Thus, the function is:

$$y_t = \frac{x_t \cdot \lambda}{1 + \exp(\beta_0 + \beta_1 \cdot t)}$$

In the case of Austria, Belgium, France, Germany, Ireland, The Netherlands and the UK in order to achieve the set targets a very intensive, exponential growth is needed. In Germany, if the organic land area growth will not be stimulated, the set percentage target will be reached only in 2020. The rest of the countries, if the development process stays the same, could reach their set targets in time.

3.1.3. The effect of GM crop production on the growth of organic farming

As mentioned in the literature review, the effect of the GM crop production should also be taken into account. Since the production of these crops was raised only in 2005, even then only in a theoretical level, therefore a third scenario was formulated. I assume that in 2010 the growth of the organic land area will stagnate, but due to the stimulating effects this will not stay long. Thus, the expected growth is modelled starting from the saturation level of the long-drawn S-curve modelled above.

In the third scenario I have determined the saturation level by taking into account also the effect of GM crop production. In order to determine the expected production area for GM crops the results of Popp et al. [2007.] was used as a base. Based on their calculations the area of GM crop production could be 120 thousand hectares in 2012. This means that it is a 0.05% of the total agricultural land area. Thus, in the other EU countries also 0.05% was assumed.

For those countries where the isolation distance was regulated by the state, the figures determined by law were used for calculations. For the other countries the isolation distance was assumed to be 20 meters.

As an affect of the GM crop production the maximum available land area should be modified by the production area of GM crops and the isolation area attached to them. The maximum land area was reduced by these two areas and this figure, the total agricultural land area, was taken as a base for the percentage targets of each country. I also analysed the change of the areas taken from agricultural production over time. However, this was significant only in France (r^2=0.94 by using power function), therefore, in the further analysis it was not taken into account.

The saturation level of the logistic function is modified by the following:

$$k = [x_t - z_t(1+r)] \cdot \lambda$$

where:

x_t = the size of the agricultural land area in 2012 (ha)
z_t = the expected area of GM crop production in 2012 (ha)
λ = the target set by each country for organic land area in a proportion of the total agricultural land area
r = isolation factor

The isolation factor is the size of the area for 1 ha GM crop. Thus, it can be determined by the proportion of the isolation area and the production area as the following:

$$r = \frac{2 \cdot \varepsilon \cdot \omega + 2 \cdot \alpha \cdot \omega + 4\omega^2}{\alpha \cdot \varepsilon}$$

where:

ω = the isolation factor determined by each countries' regulations (m)
ε *and* α = the width and the length of the GMO production areas (parcels) (m)

The size of the isolation area is determined by not only the isolation distance, but also by the shape, perimeter of the production area (parcel). This can be seen by rearranging the equation:

$$r = \frac{4\omega^2 + \omega \cdot 2(\alpha + \varepsilon)}{\alpha \cdot \varepsilon}$$, where 2(α+ε) the perimeter of the parcel

The perimeter of a quadrangle is the smallest if it is a square. Since there is no information about the perimeter of the parcels, only about their average production areas, the third scenario is divided into two sub-scenarios.

The size of the different production areas in both sub-scenarios was between 20 ha and 130 ha by using 10 ha scale. For the model calculations the perimeter of the production area was determined based on this.

The different isolation distances in both sub-scenarios were between 20 m and 75 m with 5 m scale. However, because of the Hungarian, Slovak and Portugal regulations, model calculations were made also for bigger than 100 m isolation distances, with 100 m scale until 400 meters.

In the first case the production area is a square (α=ε), thus it has the smallest isolation area.

The fist sub-scenario of the third scenario:

$$y_t = \frac{[x_t - z_t(1+r)] \cdot \lambda}{1 + \exp(\beta_0 + \beta_1 \cdot t)}$$

where:

$$r = \frac{2\alpha\omega + 2\varepsilon\omega + 4\omega^2}{\alpha^2} = \frac{2\alpha\omega + 2\alpha\omega + 4\omega^2}{\alpha^2} = \frac{4\alpha\omega + 4\omega^2}{\alpha^2} = \frac{4\omega(\alpha + \omega)}{\alpha^2}$$

After determining the isolation factor (figure 3. and 4.) the size of the isolation area in different countries and the size of the areas that potentially fall out were calculated. In the case of a 120 ha GM crop production the size of the area fallen out is above 140 ha, this is higher than the ever existed organic land area.

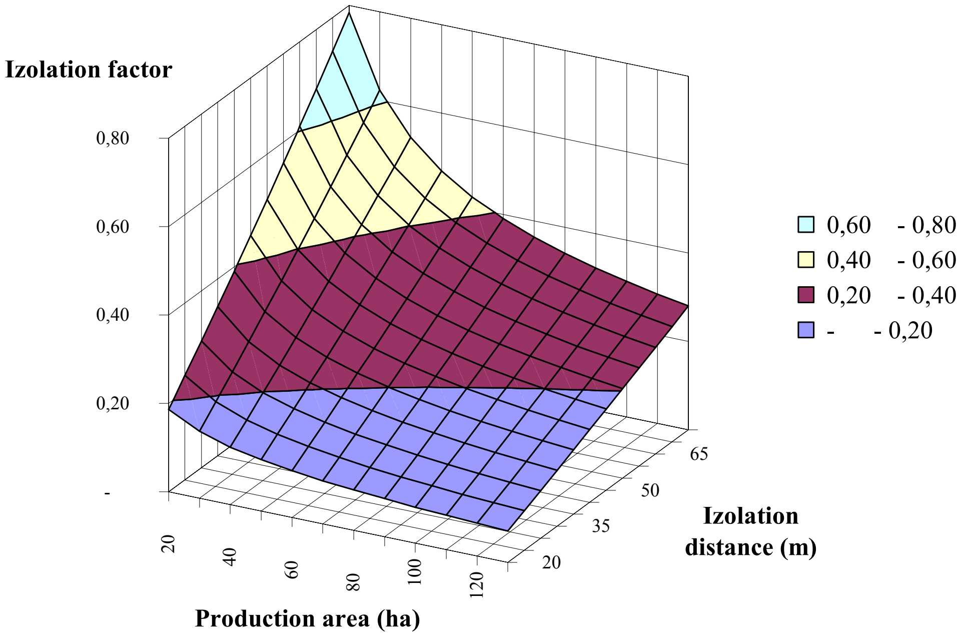

Figure 3. Isolation factor for different production areas in size and shape (in square) and different isolation areas (smaller than 75 m)
Source: own calculations

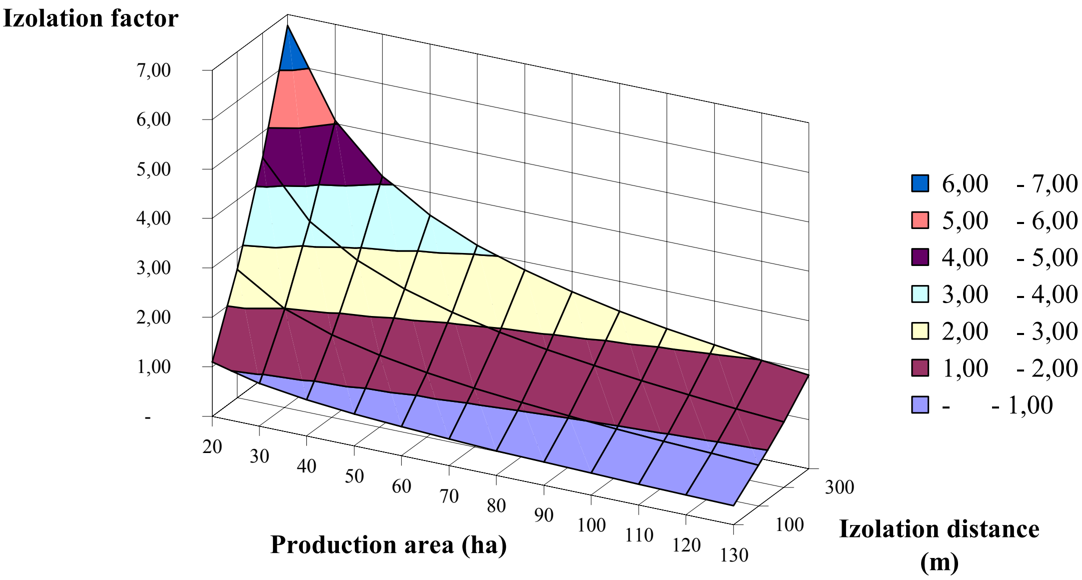

Figure 4. Isolation factor for different production areas in size and shape (in square) and different isolation areas (bigger than 100 m)
Source: own calculations

In the second sub-scenario of the third scenario the production area has a rectangle shape, where the length of one side is double of the other side, but the area stays the same. ($\varepsilon = 2\alpha$).

$$y_t = \frac{[x_t - z_t(1+r)] \cdot \lambda}{1 + \exp(\beta_0 + \beta_1 \cdot t)}$$

where:

$$r = \frac{2\alpha\omega + 2 \cdot 2\alpha\omega + 4\omega^2}{2\alpha \cdot \alpha} = \frac{6\alpha\omega + 4\omega^2}{2\alpha^2} = \frac{3\alpha\omega + 2\omega^2}{\alpha^2}$$

The maximum value of the isolation factor – in Hungary on a 20 ha, 300 m isolation distance - is 7, that is for 20 ha organic area the isolation area is 140 ha. This is an extreme number, but can occur also in practice.

In some countries the question of the isolation area can seem not to be that important at a country level, however, at farm level it has more importance how big the area is that left out from production.

The question rises, how can these isolation areas be utilised? One of the utilisation methods can be forestation or plantation of forest belts.

Since the isolation distances do differ between the countries, it has an influence on the area that could be utilised for agricultural production. Hereby they have a significant impact on the production of agricultural products, which could lead to a competitive disadvantage in those countries where the isolation distance is set to be bigger.

The model calculations with all three scenarios were done also for all other EU countries (except Malta and Cyprus, where the organic land area is very small, and Bulgaria, where there was not enough data available for analysis), however, with the difference that the proportion of the organic land area of the total agricultural land area is not 10% but only 5%. The results were the same, thus the growth of the organic land area can be approximated the best by using logistic function.

3.2. Factors influencing organic farming: premium price, subsidies, economic development

3.2.1. Theoretical approximation of premium prices for organic products

The additional value of organically produced products (without chemicals, with stricter regulations on animal welfare etc.) is reflected in their higher price, so called premium price. However, this higher price in the long-term is determined by the supply and demand for these products.

Ács [ÁCS, 2006.] has proven with a simulation model that the price and the yield risk has the biggest influence on the conversion to organic farming, thus, the analysis of the prices is necessary.

With the classical economy approach, as Takács [TAKÁCS, 2006.] and Hamm [HAMM, 1994.] as well – although the latter was analysing the effects of subsidies – I illustrate the impact of supply and demand on premium prices and through prices on supply, production (figure 5.)

At the start of the organic production, in the time of the movements, - in the 1970's – there was a difference between the demand and supply where the demand was higher than the supply (P1, Q1 point on figure 5).

During the boom of organic production – in the 1990's, when the area of organic farming was growing, as the most expensive capital for production – both the demand and supply was growing on the organic market (thus, both functions shifted to the right, but not in the same pace, since the demand was growing faster). As a consequence, the equilibrium price was lower, and still is, than before. This happen because, if the demand for a product does not grow in the same pace, then the producer has to sell his product for a lower price. Although, the additional value due to production method used does not change, however the market will not pay for this additional value and the price of the organic products will be lower relative to the conventional product prices (P2, Q2 point on figure 5). This equilibrium price is anticipated by an oversupply, the effect of which the Hungarian producers even nowadays perceive.

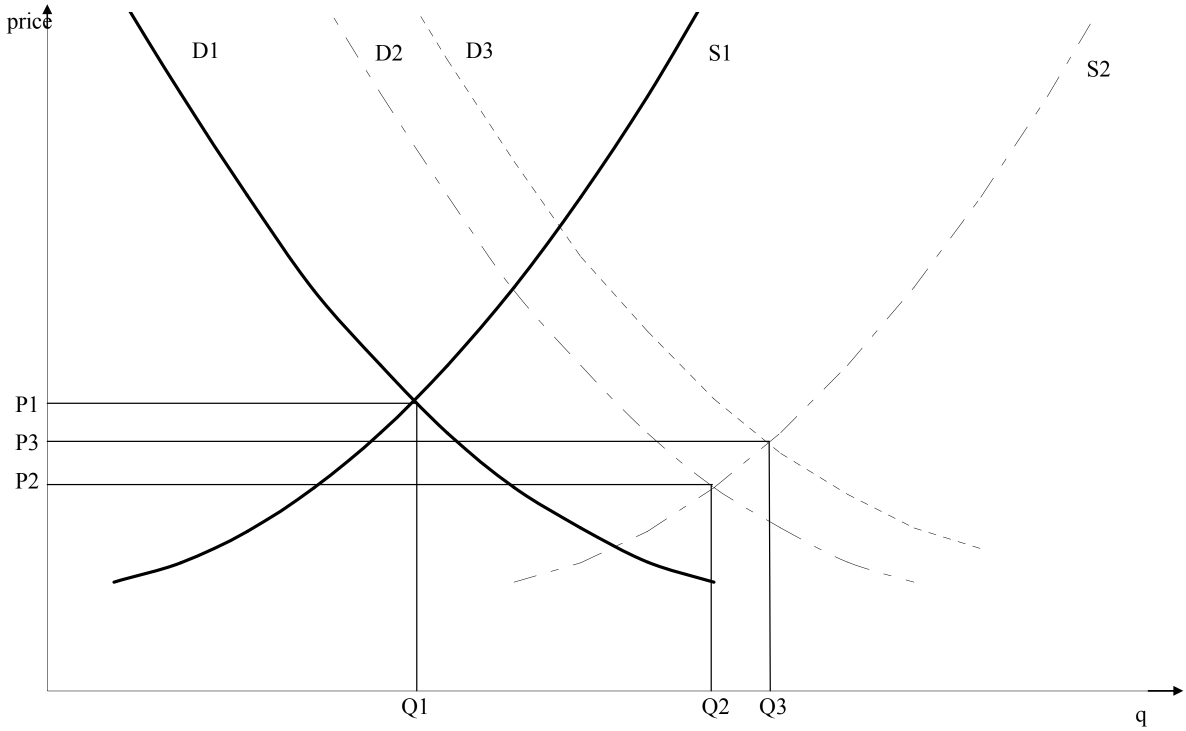

Figure 5. Impact of supply and demand on organic premium prices
Source: own calculation

In the next phase the demand is expected to grow due to the advertisements. As a result the premium prices for organic products will shift to point Q3, P3 on Figure 5.

The premium prices of organic products will depend solely on the equilibrium of supply and demand, and in the long-run the demand will be expected to grow with a slower pace, because the organic products will not become bulk products, they just do satisfy the different consumers' needs [PANYOR, 2007.]. To find appropriate information and data on premium prices - in order to apply the theory in practice - was hardly possible, due to the differentiation of the products and the lack of information on premium prices. Other studies [FÜREDINÉ et al., 2006.; KIS, 2007.] also showed that to adjudge the premium prices is not an easy task. Földes and Döme [FÖLDES – DÖME, 2008.] has measured the premium prices for some products, which were 46% for fruits and vegetables, 52% for milk and milk products, 68% for meat and 32% for eggs.

At an international level it was measured that for some animal based products the premium prices have disappeared. 32% of organic milk, 31% of organic beef and 46% of organic sheep and goat was sold on conventional prices [HAMM – GRONEFELD, 2006.]. In Hungary the premium prices for organic animal based products on average is between 45-150% [FÖLDES et al., 2008.]. In general we can say that due to the constantly growing supply organic farmers get lower premium prices each year [SALAMON et al., 2008.], and sometimes happens that they do not even get the premium price [AGRÁR EURÓPA, 2004.].

However, we cannot talk about all the organic products as one group. Takács [TAKÁCS, 2006.] has separated the products with higher (above 100%) and with lower (below 100%) premium prices. Takács also has categorised the consumers of organic products in four different groups: activists, snobs, health-conscious consumers, mass consumers. These consumer groups by getting to know better the attributes of organic products, that is by time, could be created also on the Hungarian market; however, until now in Hungary no organic consumer groups were formed [SZENTE, 2005.].

For price formations one more thing is important, „we cannot say that the prices for organic products are high, only because the conventional product prices are low" [WILSON, 1999.]. In my opinion Wilson is right, because the prices of agricultural products are indeed very low.

3.2.2. Differentiated support of organic farming across Europe

One of the motivations to grow in an organic way is the subsidy support, however, this support differs across countries. It can be assumed that the homogenous groups, created by the cluster analysis, have the same level of organic farming, higher proportion of the total agricultural land area.

The countries that belong to the first cluster are all the EU-15 countries, except Greece, Luxembourg and Portugal. The latter two countries were left out due to the low agri-environmental expenditure in these countries. In Luxembourg under the agri-environmental schemes agriculture is not supported at all, therefore it constitutes a separate cluster. In the first cluster countries the support of organic farming and the expenditure on environmental protection and agri-environmental issues is significantly higher. The countries belonging to the second and third clusters all joined later to the EU. In these countries the farmers are not supported in that extent after the conversion to organic farming than during the conversion period itself.

3.2.3. Analysis of the relation between organic farming and economic development

Organic farming compared to conventional farming a more complex way of production which needs more attention. For these additional tasks the farmers do expect an extra money, premium price, thus higher price than for the conventional products. This price however has to be paid by the consumers. We can assume that the solvent demand is high in those countries where the economic development is higher. Currently, for measuring economic development of a country GDP or rather GDP per capita is used. During my calculations the consumption parity was based on GDP per capita.

Next, I analysed in the EU countries that whether this statement is true, that is, in those countries where the GDP per capita is higher the proportion of the organic land area, the numbers of organic farms are also higher. As a matter of course the run of export-import could change the cause and effect relation between production and consumption of organic products.

The results ***do not prove that in the economically more developed countries the proportion of organic land area is significantly higher***.

There are two alternative economic indexes HDI and GPI. I analysed that in the case if GDP is replaced by these indexes than whether there is a stronger relation between the proportion of the organic land area and the economic development of a country.

One basic principle of organic farming is that these products should be sold locally within a country, not to put burden on the environment by transportation. Thus, assumable that the higher portion of the products is sold internally. Therefore, the existence of a solvent demand can be examined by analysing the relationship between the size of the organic land area and the realisation of organic products.

The results ***do not prove the hypothesis that where the size of the organic land area is bigger there the consumption of organic products is also bigger***.

Hereinafter, I analysed the relationship between the support of organic farming and the size of organic land area. The hypothesis was that there is a strong, positive relation between them. However, this hypothesis was also not supported by the results of the analysis. Thus, ***even in those countries where the support of organic farming is higher the size of the organic land area is not bigger.***

3.3. Analysis of organic farming in Hungary

During the analysis of the Hungarian organic farming the production area of different crops were analysed in details. ***The winter wheat is the most important organic arable crop in Hungary.*** The area of its production grew dynamically until 2003, then it decreased significantly by 2005 and even by 2007 did not reach the level of what was in 2003. In 2006 the converted land area (8,8 thousands ha) was bigger than that of the previous years (4,5 thousands ha) and the area under conversion (2,4 thousand ha) together. In 2007 the converted land area was higher as well (11,9 thousand ha) than the converted (8,8 thousand ha) and the area under conversion (1,8 thousand ha) together in 2006. Similar problem can be observed with the production area of oil squash, herbs and the sizes of the forest areas as well in 2002.

The production area of oil squash was reduced significantly by 2004, due to the problems with realisation, and although there was an increase in the land area in 2005, in 2007 it had a significant decrease again. The production area of organic sunflower in 2003 was the biggest (5,5 thousands ha), and since then it is reducing continuously, due to the difficulties in the production technology.

The production area of organic maize has not increased significantly since 2001.

The production of organic arable and glasshouse vegetables has not increased remarkably since 2001, however, these products could give a break-out point for organic production, since, according to the results of market research, for these products would be the demand the highest.

The next two chapters describe the analysis of the production structure in details.

3.3.1. Analysis of the production structure by means of Pareto-analysis

By using Pareto-principle for analysis the results show that the size of the organic area is influenced in 72% by meadow, pasture and grain crops, that is, these factors can be put in category A. The factors of category A, the bulk fodder, industrial crops and the area of fish lake, forest, reed together influence the size of the organic land area in 94%, that is, these factors are the units of category B. The other factors (fallow; fruit plantations; protein plants; fresh vegetables, melon, berries; grapes, seeds, other perennial plantations; potato) are belonging to category C, since these factors/products do not influence the size of the organic land area in a great extent.
The separation by each crop clearly shows why the supply cannot suit the expectations of the demand.

3.3.2. Categorising the basic commodities of organic products by means of BCG-matrix

By means of BCG-matrix the following categories were created:

- ***Question marks*** – the relatively new products, which still have a low market share and they have a chance for a rapid growth. At this stage they still have a week position on the market, however, those products which could be stars with sufficient support. Based on my calculations these products are: herbs, seeds, rye and plantations.
- ***Stars*** – those products that have the best position on the market, since they have high market share and high growth on the market as well. Mostly these products are those which determine the future. Therefore, it is worthwhile to support the production of these products, since these can become milking cows. In this category the following crops can fall: bulk fodder, rape and other grains.
- ***Milking cows*** – those products that have very high market share, but there is no possibility for further intensive growth, since the market is full. These products are

worthwhile to support only for keeping their strong position on the market. The following products can be included in this category: winter wheat, spelt, sunflower, oat, barley and fresh vegetables.

- ***Dead dogs*** – those products which do not have adequate market share and their possibility for growth is not sufficient. Nevertheless, one should not prepare for taking these products away from the market – oppose to the classic marketing strategy – because, due to the strict rotation, without these products it would be impossible to realise organic farming. This also explains why so many crops, products do belong to this category: soy-bean, potato, root crops for fodder.

I analysed the areas and crops that already converted (organic) and those that are still under conversion (conversion), however, they did not show significant differences, and during the production there is no difference whether it is organic or conversion crop.

After the preparation of the BCG-matrix the results were checked by K-centred cluster analysis, which gave the same results.

3.3.3. Results of model calculations for organic farming in Hungary

After economic analyses I examined how the already introduced growth models do fit the situation in Hungary. The results are shown in Figure 6.

In Hungary the intensive growth of organic farming during the millennium has stopped and ***since 2004 the size of organic land area is decreasing***. In the second scenario in order to reach the targeted of 5% - the proportion of the organic land are within the total agricultural land area – the size of the organic land area should be raised significantly. To choose the right tool for stimulation is the task of the agricultural policy. However, the main aim would be to break down the existing barriers, already mentioned in the literature. The most significant are the following:

- Reduction of prices for monitoring and labelling;
- Technological change in organic farming;
- Direct production support;
- Promote the growth of demand by informing the consumers.

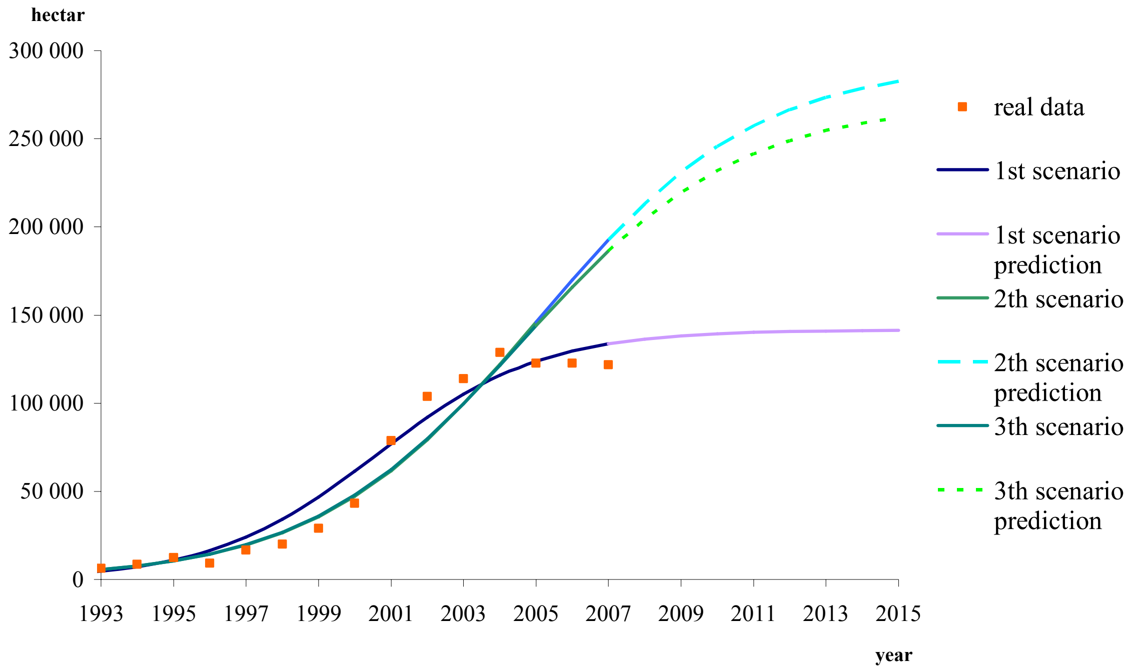

Figure 6. Development of organic land area in Hungary based on observed data and model results from own calculations

Concerning the GM crop production the results show that if in Hungary the production of GM crops will be permitted then the opportunities for growth for organic farming will not be influenced significantly. Based on the model calculations – if the growth of organic land area is described by natural logarithmic function, and we assume that by 2010 the proportion of organic land area of total agricultural land area will reach 5% then – in 2010 the size of the organic land area could be by 14 thousands hectares lower due to the GM crop production. In 2015 this value could be 20 thousands hectares.

Based on this, the fact is that the growth of organic farming is not influenced significantly by GM crop production. However, we cannot dispense with the fact that the cultivation and the maintenance of isolation areas will give a big challenge. For 120 thousands hectares, forecasted by Popp at all., calculated by 400 m isolation distance the size of the isolation area would fall somewhere between 228 thousands and 800 thousands hectares. It is quite difficult to give an exact number, since the isolation area is influenced not only by isolation distance, but also by the size of the parcel.

4. CONCLUSIONS AND RECOMMENDATIONS

Organic farming that started in the 1920's and was cultivated only by a small group of farmers as activists until 1970's. Nowadays it has extended and have a significant area of production in every continent, however, the growth has started to come to an end in Europe where this production method had started. Earlier scientific experts were too optimistic concerning the market extension. With the everyday experience we can see that the supply is growing with a bigger extent than the demand. Due to the changed habits in consumption the requirement for the processed food is constantly growing. As a consequence of this the further development of organic farming could be the split of raw material production and processing. Of course, the most important question in such a case will be that who will pay for the price premiums for those organic products which the consumer pays relative to the conventional prices. Most probably, as also for conventional products, in the case of organic products the processing companies would have the extra premiums.

The European Union provides support for breaking down the obstacles that cause reduction in the size of organic land area and helps to realise the market extension of organic products. However, this support can be helpful only if all the countries prepare separate action plans, especially the Eastern European ones.
In these action plans the emphasis should be given to market extensions and to appropriate marketing tools. While settling the national action plans special attention should be given to the solvent demand and the market effect of cheaper products coming from East Asia.

Concerning the GM crops we can say that in the case if Hungary will give a permit for producing these crops then the possibilities for growth of organic production would not decline in a significant extent. However, we could not ignore that the cultivation and maintenance of isolation areas would give a challenge for the producers.

After the literature review I can draw the following conclusions:

- The profitability of organic farming is decreasing across Europe. In Hungary without subsidies it is not profitable to produce organically, according to the model calculations for 2007, and the farmers should be informed and prepared for this;
- Terms that are used by the researchers are very diverse, however the regulatory rules are straightforward;
- In my opinion, organic farming – if it is realised in a closed system – is more sustainable, than any other agricultural system, however we cannot say that it is fully sustainable in all aspects;
- National and international research has already determined the constraining factors that globally and locally have a negative impact on the growth of organic farming. To develop an appropriate information system is the task of agricultural policy makers and civil organisations;
- The future possibilities of organic farming are influenced by GM crop production, thus, in the next years the impact of these should also be taken into account, and a proper database of the size of GM crop production area should be made.

Main conclusions of my research results:

- In the EU-15 countries the biggest part of the organic land area is occupied by grass, and these areas are only partly used for livestock production. Since on the European market the most significant overproduction is coming from animal based products, Hungarian producers are not recommended to switch to this type of production;
- The growth of organic land area is slowing down rapidly, and significant growth is not expected in the future. This means, that we should accept that organic farming also has an upper limit, and not all of the farmers will convert, even if this would be the best solution from the environmental point of view.
- From economic point of view production of GM crops is not realizable, but the proper legal regulation can help to realize organic farming and production of GM plants. One way of utilisation of the isolation areas could be the plantation of energy forests;
- The size of the organic land area is not bigger even in those countries where the financial support is higher, thus, different tools should be used to stimulate farmers to convert;
- In the production structure in Hungary, similarly to other Eastern European countries, the arable crops are dominating, oppose to the fact that the market demand has shifted towards the processed products and fresh fruits and vegetables. Furthermore, Hungarian organic farming is also characterised by the disequilibrium between crop and livestock production;
- Hungarian organic farming is not affected substantially by GM crop production, from economic point of view.

5. NEW SCIENTIFIC RESULTS

„The characteristic of a scientific research is that it observes all new statements with a critical view until the statement is not supported by several proves." [Láng, 2006.]

My new scientific results are summarised in the following points:

1. I proved that if the size of the organic land area grows in this pace, and the effect of the currently known constraining factors are not reduced, then in the ***EU-15 countries the size of the organic area will reach the maximum of 6 million hectares in 2010,*** the prove of this I have done by using a logistic function. As a result of the function fit I have got a trend function, which is similar to the product life-cycle curve well known and used in marketing;

2. I have calculated the isolation factor - for a square shaped parcel – as a function of the isolation distance, determined by regulation for GM crop production. This factor is equal to the isolation area of a 1 ha GM crop production area. This function is:

$$r = \frac{4\omega^2 + \omega \cdot 2(\alpha + \varepsilon)}{\alpha \cdot \varepsilon}$$

   where:

   ω = isolation distance by regulation (m)

   ε *and* α = the width and the length of GM crop production areas/parcels (m)

3. I proved, by making analyses using isolation factors, that ***GM crop production will not reduce significantly the possibilities for organic production concerning its land area.***

4. I proved that ***there is no relation between economic development and the proportion of organic land area***, thus, the basic principle of organic farming is not supported, which states that the products are produced on the place where they are consumed.

5. I have developed a ***theoretical model***, and I analysed and characterised the development of organic premium prices over time.

6. The Hungarian organic farming cannot develop further, not only because of the fact that the international market is getting filled, but also due to the inadequate production structure;

6. Summary

The topic of this thesis is the economic conditions of conversion to organic farming. Several factors could be analysed within this research area; however, a more specific topic was chosen as a subject for this study.

First, I carried out a national and international literature review within this topic; I then organised it and contrasted different opinions with each other. Within the literature review, I made an overview of the definitions of organic farming, its formation and development. During the overview of the definitions, the expression of sustainable farming was important, and subsequently the literature on relations between sustainability and organic farming.

So far, the economic value of a farm at national level has been measured by valuing its contribution to the GDP. However, nowadays the experts are using more and more new indexes in order to show the importance of different individual farms and of different activities within the farm. I have overviewed these new economic indexes as well.

Concerning the future of organic farming, several optimistic opinions were formulated at national and also international level. I have also overviewed these targets and opinions.

Beyond the formulated optimistic hopes, several studies were done at national and international level on the constraining factors of organic farming, so the organization of these factors was necessary.

Organic farming is the most „environmentally-friendly" farming practice; however, other farming practices are also present and their role is increasing to a large extent in the world production. One of the most intensively developing farming practices is the production of genetically modified plants, which could push out organic farming from production. That is why it was important to overview the development of GM crops, their role in the world, and the rules of coexistence from the point of view of organic farming.

I have done a brief overview on the methodology of futurology, which gave the base for the analyses on prediction of development tendency of organic farming.

I tackled the growth of organic farming by using logistic function and I got the product life-cycle curve, in marketing well known function. Based on this in the EU-15 countries, the extent of organic land area will reach 6 million hectares, if the size of the area under organic production grows at the same pace. Thus, it will happen if the constraining factors do not reduce its effect, referred to in the literature review. I analysed the need in the growth of organic land area for different countries in order to achieve their extremely optimistically set targets.

Based on the regulation for the GM crop production, with the help of the specified isolation distance, I expressed the isolation factor, that is the area of isolation for one ha GM crop. The suppression level of the logistic function was reduced by this factor and I predicted the future development of organic farming. The results show that the production of GM crops does not significantly reduce the opportunity for organic farming; however, the use of the isolated areas will be a new task for the producers.

In the case of the EU countries, there was no strong positive correlation found between the level of economic development and the proportion of organic land areas.

I have illustrated with a theoretical model the development of premium prices of organic products.

I have analysed the past, present and future prospects of organic farming. As a result, I found that the production structure of the Hungarian organic farming – similar to the other countries – has not changed since the beginning of this production method. The relatively high areas of pastures and meadows are not supported by the number of livestock.

In general, we can say that organic farming has perspective in food stock production; however, one should not be too optimistic about further growth in its production area.

Proved hypothesis:

- The growth of organic farming is slowing down and it is close to a maximum value. The upper boundary of it in the case of developed markets will be determined by organic product prices.

Rejected hypothesis:

- The ban on the production of genetically modified crops has an economic advantage for organic farming.
- There is a strong positive correlation between the level of economic development and organic farming.

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