THESIS OF DOCTORAL (PHD) DISSERTATION

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ECONOMIC ANALYSIS OF PRODUCTION FACTORS AND WEED MANAGEMENT METHODS IN ORGANIC FARMING

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1. INTRODUCTION, OBJECTIVES AND HYPOTHESES OF THE THESIS

Conservation of natural values, protections of environmental values has become a dominant part of the socio-economic life by now. At the back of it there is on one hand the increasing use and depletion of natural resources, and on the other hand the increasing quantity of pollutants released to the environment as an effect of different activities.

The organic farming movement started in the 1980s in Hungary, which – at least initially –contributed to the alleviation of the surplus in agriculture, but also serves environmental purposes. It means an alternative solution for less-favoured areas, thus contributes to the avoidance of the abandonment of centuries-old agricultural areas under cultivation.

Despite government efforts the share of organic farming in Hungary is currently fluctuating around 2.5%, showing a decreasing trend. Firstly the lack of information, secondly the insufficient solvent demand causes the low domestic demand. A part of the organic farmers has switched to the so called integrated programmes due to the favourable conditions and higher subsidy amounts. The biofuel production encourages the farmers to allocate the land for biofuel production; this could lead to further decrease of organic farming.

The main objectives of the doctoral thesis can be summarized as follows:

- to determine the main factors of production characteristics of organic farming as a result of its research, to compare it with the data of conventional farms with the help of secondary databases, to explore the differences between the two production systems in case of labour and land use;

- to analyze the gross production value, the cost structure and the main profitability indicators of private farms and economic organizations based on the data of the Farm Accountancy Data Network (FADN) of the Research Institute of Agricultural Economics between 2004-2007, to determine the differences of the cost structure of conventional and organic farms; to explore the possible reasons;
- to survey the applied weed control methods of domestic organic arable crop producing farmers based on a questionnaire; to determine its time and cost demand, to survey the farmers' attitude towards weed control with a reaction analysis, and to outline the context why the farmers apply the given weed control method;
- to develop a profit-maximizing model through the combination of the primary and secondary survey results, which provides through the combination of the ecological and economical benefits of the system a basis for the farmers to choose the crop rotation.

The hypotheses related to the objectives are following:

- the indicators of production factors are significantly different between the conventional and organic farming methods, as well as the various operation forms of organic farming;
- to prove - based on primary and secondary databases - that the surplus value of organic products has been on a declining trend over the past few years, so the deficits observed in the yields are more difficult to counteract;

- the producers prefer those mechanical weed control methods which are the more common, usually cheaper, and also applied in conventional farms;
- the marginal territory of mechanical weed control increases where sufficient (cheap) hand labour is available.

2. MATERIALS AND METHODS

The research has mainly been based on foreign literature because of the novelty of the topic. The dissertation has used two data collecting methods. The primary survey acquired information from the surveyed statistical population (private organic farms and organic economic organizations controlled by Biocontroll Hungary Non-Profit Organization) during two questionnaire surveys (2005, 2007); while the secondary survey was carried out with the help of existing databases. The methods of weed control in organic farming on current experiences and ideas were collected with a questionnaire.

The first questionnaire (2005) focused on the cultivated crops, the yields of the previous three years, the average sales prices as well as the weed control methods used in different cultures and their frequency. The second questionnaire (2007) stressed the machine and hand labour demand and cost of the applied methods. Open-ended and interval scale questions could be observed besides questions relating to specific figures.
44 (14.7%) questionnaires were returned and evaluated in the first survey, while during the second survey this amount was 55 (27.5%). The questions concerning specific data dominated in the first survey, while there were more interval scale questions in the second survey.

The economic studies were based not only on primary, but also on secondary databases. Domestic databases were used for secondary data collection: the Central Statistical Office

(CSO), the Biocontroll Hungary Non-Profit Organization and the Research Institute of Agricultural Economics files. The FADN of the Research Institute of Agricultural Economics supplied data concerning the years 2004, 2005, 2006 and 2007. The following indicators were evaluated based on the secondary data: return on total output (%), return on assets (%), return on net worth (%), return on labour (1000 Ft/AWU).

The correlation between statistical population with rank numbers were calculated in case of two rankings with Spearman's rank correlation (r), while Kendall's concordance index (W) was used in case of more than two rankings.

Organic farming leaders had to assess pre-defined claims on a scale from 1 to 5, and from 0 to 3. The responses were evaluated with the determination of rank-sum, average, standard deviation, variation coefficient and Kendall's concordance coefficient. During the analysis the author wanted to create three classes of typical figures, the smallest impact factors, the medium and above the average ones.

The correlation coefficient (r) used to determine the connection between weed control efficiency, cots and frequency.

The most matured scope for linear optimalization models is the optimalization of company production structure. Such an optimization model was set up, developing alternatives of the limiting factors, where the goal was to maximize the result of farming activity. The studies were conducted with growing number of conditions, such series of solutions were found, which showed increasingly improving approximations of the ideal course of the action. Since the conditions in the real world are constantly changing, there may be modifications, which invalidate this model, however if the changes do not affect the organic farming systems as a whole, the model can be applied; only the optimal outcome figures will be modified.

3. RESEARCH RESULTS AND THEIR EVALUATION

The research results chapter of the dissertation has a triple structure in which two current data collection methods were used. The first part of the survey used the secondary data collection, while the second part the primary data collection and the third one the modeling.

The data collected by the FADN of the Research Institute of Agricultural Economics are found in the first part regarding the years 2004-2007. Relaying on the information base the characteristics of production factors and profitability indicators at private organic farms and organic economic organizations were determined.

The primary data collection of the second unit was carried out by two questionnaire surveys (2005, 2007), which included both private organic farms and organic economic organizations. The characteristics of production factors, production value and weed control methods were named.

The third unit contains a diversification model resulting from the combination of primary and secondary data.

Nowadays, the main demand for management systems has to be both economical and environmentally friendly, namely to adapt to economic and ecological conditions. However the short-term economic competitiveness decides still the viability of cropping technologies in agriculture.

The higher labour demand and the tight audit – beginning at the conversation period, lasting via the production process until the final production and packaging – of the organic farming does not make it popular among farmers interested in mass production.

Simply the market needs cannot affect the establishment of the product structure in organic farming. The prescribed conditions dictate a product structure after a determined crop rotation, which does not always coincide with the market needs. An

important obstacle in the continuing growth of organic farming is this strict crop rotation, which makes the product structure change inflexible.
Depending on culture, soil and weather conditions the yield per hectare can be the same in organic farming as in conventional farming, but the organic cultures cannot be grown at such intensity intervals due to nutrient supply and crop protection issues. The overall labour demand growth rate can be highly variable at different cultures in organic farming. The reduction of hand labour force can be the appropriate strategy on farm level, but the higher labour force need in organic farming can increase the labour demand in rural areas.
Its unemployment-reducing effect could occur especially in the unskilled strata.
Nowadays the biological plant protection methods can be competitive in cost with the purely chemical ones. The costs are mainly influenced by the applied plant protection technology, which can vary considerably from one another due to objective reasons.

A survey among organic farmers from several countries shows that weeds are the primary issue for them, mainly in the conversation time. The main limiting factors of weed control are the cost, the available machines and the lack of capital. Essential external limitation factors can be the availability of effective and controlled inputs (fertilizer, seed), post-harvest handling and processing, also marketing opportunities. The cost-effectiveness of weed control methods is affected by the following factors: labour cost, weed density and the availability of organic premium.

The results of the survey regarding the production factors and weed control methods of private organic farms and organic economic organizations in Hungary:

1. A significant difference of farm size at different farm types cannot be determined regarding the years 2004-2007 based on data of the FADN of the Research Institute of Agricultural Economics – taking into account that in each year different farms were surveyed. The FADN farms do not make full use of available subsidies further worsen their market position against conventional farms. The net income of organic private farms and organic economic organizations do not meet the conventional ones' in the examined years due to smaller yields and gradually declining average sales prices. The profitability indicators of organic private farms have improved in the reported period, while the organic economic organizations' have declined.

2. The farmers' feedback to the questionnaire named the limited amount of available resources, the prevailing economic situation, the considerations of environmental protection, as well as the leader's age as the main limiting factors.

The primary data confirmed the secondary data in case of labour, however this has not been met in case of land use. Due to the oversupply, the surplus value of organic products is declining from year to year, in 2005 – depending on the product – about the same price levels occurred, backing the FADN data. In general, the yields of organic farms were 10-30% lower, probably due to the worse-favoured places of production, than in the conventional ones. The primary results of the survey showed, that the different cereals had 10-40% lower yields, in case of the hoe crops this ratio was between 5-30%.

- The following factors have an above-average impact in weed control: weeds reduce the yield, it has priority in the production system, worsens the quality of yield. The limits of

an effective weed control are due to the high degree of homogeneity of values: environmental conditions, weed control costs, capital demand of investments and the available machines. In particular, the data concerning the acquisition of new knowledge showed extreme volatility. The majority of farmers attributes to only one factor a prominent role, they reckon the yield reduction as the main source of damage.

- The most common indirect weed control methods are crop rotation, choosing the appropriate production site as well as the optimal means of tillage. Mechanical weed control – either manually or by machines – is widespread.
- There is a positive moderate correlation between the effectiveness and the frequency of weed control. The costs and the frequency of weed control have a negative moderate correlation. However, no correlation can be observed between efficiency and costs.
- The combination of mechanical and manual weed control methods are economically preferable, if you have high labour costs, bigger farms size and higher weed density. On the contrary low wages, high unemployment-rate and smaller farm size make the manual weed control economically advantageous, unless weed density is high or the ancillary costs are low.

3. The results of the optimalization study are summarized below:

- The private farms have the opportunity to grow 4 cultures; considering that the rather small farm size, the appearance of additional costs and the lower sales prices fewer cultures are involved.
- The economic organizations have the possibility to grow 5 crops; in addition to economic, the ecological aspects prevail, too; as more crops are involved into the crop rotation.

4. CONCLUSIONS AND SUGGESTIONS

The legitimacy of organic farming is not only confirmed with its benefits at quality issues and environmental protection, but also with its yield stability at unfavourable weather conditions.
In contrast with the reduction of average sales prices the constant increase of inputs (material, ancillary and labour costs) is observed. The author believes due to the unfavourable processes the number of organic farms – mainly the small farms – will be further reduced. It is still not possible to maintain a farm system in a long-term without the appropriate subsidization of externalities, which places the economical principles – as far as it is possible in today's market economy – behind the ecological ones. A solution would be if the private organic farms would unionize into a vertical integration, and the added value of organic products would be increased with the establishment and expansion of processing capacities.
Prevention can contribute to the reduction of direct weed control costs by observing the biotic and abiotic environmental factors. As this implies many years of professional experience, so the dissertation proposes the establishment of forums and blogs on the Internet as well as the organization of training with the involvement of organic farmers and consultants. Direct weed control is achieved firstly mechanically - manual and by machines. Due to lack of capital the most common methods in organic farming systems can be observed in the conventional farming systems, too. The applied weed control method is not determined by its cost in the farm, the more expensive methods not always prove to be the most efficient ones.
It is difficult to obtain reliable data regarding the time consumption and cost of weed control, because the majority of farmers does not lead a separate record despite these factors affect their profitability notably.

Changes – promoting the economic adaptability - made in the structure of the existing registration system e.g. Farming Diary could provide information not only for the farmers, but also for various professional and scientific circles to enable rational decision making.

The surveys confirmed the hypotheses regarding the surplus value of organic products, the preferred methods of weed control, and the marginal land size. The hypothesis related to the production factors was rejected.

5. NEW AND NOVEL SCIENTIFIC RESULTS

1. The paper found that **there are not any significant differences between the productions systems of conventional and organic farming systems considering labour demand and land use** based on the data of FADN of the Research Institute of Agricultural Economics. The comparison of conventional and organic farming showed the indicators of labour force per 100 hectare varied between 7-27%, there were significant changes in case of land use per year, which indicates that the land size is not effected by organic farming but by other factors.

2. The analysis of secondary data proved that **the surplus use-value of organic products recognized by the consumers has a decreasing tendency**. 10-20% higher prices could be obtained on the average concerning cereals and row crops in organic farms compared to conventional ones in the years 2004-2007.

3. The farmers' response survey results were classified in factor classes on the basis of data variability. The **constraints of effective weed control** can be classified into **three clusters**; the cluster of the **most important influencing factors** is formed of the **environmental and economic-financial conditions**. Subsidiary and education system can also be highlighted regarding the efficiency. The **causes of weed damage** can be **divided into three clusters** based on the survey. Above-average effect is attributed to yield reduction, while the crop contamination – control is difficult to solve – acts as a vector factor class is considered mediocre.

4. The dissertation made evident that the **labour force characteristics** (low-cost labour, high unemployment rate) **establish the application of manual weed control also economically**. Based on this it can be stated that the collective use of machine and manual weed control means a real alternative if higher labour costs, bigger farms sizes and higher weed density appear On the contrary low wages, high unemployment-rate and smaller farm size make the manual weed control economically advantageous, unless weed density is high or the ancillary costs are low.

5. **A simulation model** has been developed, **which enables to investigate the optimal structure of organic farms considering both ecological and economic factors, which should be recognized in the direction of diversification.** This model results in the profit maximalization of production activity, and provides a basis to the farmer in the development of crop rotation.

6. LIST OF PUBLICATIONS IN THE TOPIC OF THE DISSERTATION

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