SZENT ISTVÁN UNIVERSITY

Doctoral School of Management and Business Administration

COMPETITIVENESS OF THE HUNGARIAN MUSTARD SEED PRODUCING SECTOR AND THE EVALUATION OF ITS DEVELOPMENT POSSIBILITIES

THESIS OF DOCTORAL (PHD) DISSERTATION

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1. INTRODUCTION

1.1 Relevance of the topic

Nowadays, the sustainability is among the most important questions all over the world. Although mustard seed has never been a significant plant in agricultural production, it has a supporting role in the crop structure for sustainable agricultural production technologies as a result of its favourable effects: plant protection and soil quality.

Nowadays, it does not belong to the most important crop production sectors despite the fact that in the 1980s, Hungary was the largest producer in Europe, and with 10% export share, it was the second largest export country after Canada.

This tendency started to worsen in the middle of the 1990s and in the past five years the harvested area of mustard seed in Hungary was only 7 000 hectares compared to the 35 000 hectares in the 1980s. The quantity of export has also decreased significantly from the former 15 000 tons to the present 3 000 tons.

The general objective of my research was to explore the reasons of the significant decrease of the Hungarian mustard seed area, and to examine the development possibilities of the sector in the future.

1.2 Objectives of the research

The main objective of my research was to **analyse the Hungarian mustard seed sector in economic aspects, to explore the possible relations within the product chain,** and to find those directions and **development possibilities**, which might improve the stability of the mustard seed production in Hungary and **improve the performance of the whole mustard sector**.

In addition to analysing the Hungarian mustard seed market, I explored the **international market conditions**, and the position of Hungary in the rank at the international mustard export and import markets. In the assessment of the international mustard seed market, my analyses were focused on Canada, as the largest exporting country, and on the Czech Republic, which is the most important competitor of Hungary.

In the analysis of the **domestic mustard seed production and trade conditions**, I have examined the export and import markets since the 1980s in order to explore the long-term trends of this market. In addition, I wished to analyse a long-term database of the Hungarian mustard production.

I started the assessment of the **Hungarian mustard seed sector** with a survey of the Hungarian mustard seed producers, where the questions of my questionnaire were focused on the economic position of the producers, the probable problems in the production and sales, the motivations of mustard seed production and the contract relations of the producers with the processing industries. In order to explore the relations between the players of this sector, I conducted in-depth interviews with the most important producers, traders and representatives of the processing industry.

In order to explore the **profitability of the domestic mustard seed production**, I wished to focus on the analysis and the comparison of cost and income data, based on a 5 year long farm-level database. In the course of the assessment of production data, I wished to determine the impacts of yield influencing factors (such as species, fertilizer use level, irrigation) and to

determine the factors which may influence the sector's profitability. In the evaluation of the competitiveness of the Hungarian mustard market, I also explored the alternative utilization forms of mustard seed. The different stages of the research and their interactions are visualized by Figure 1.
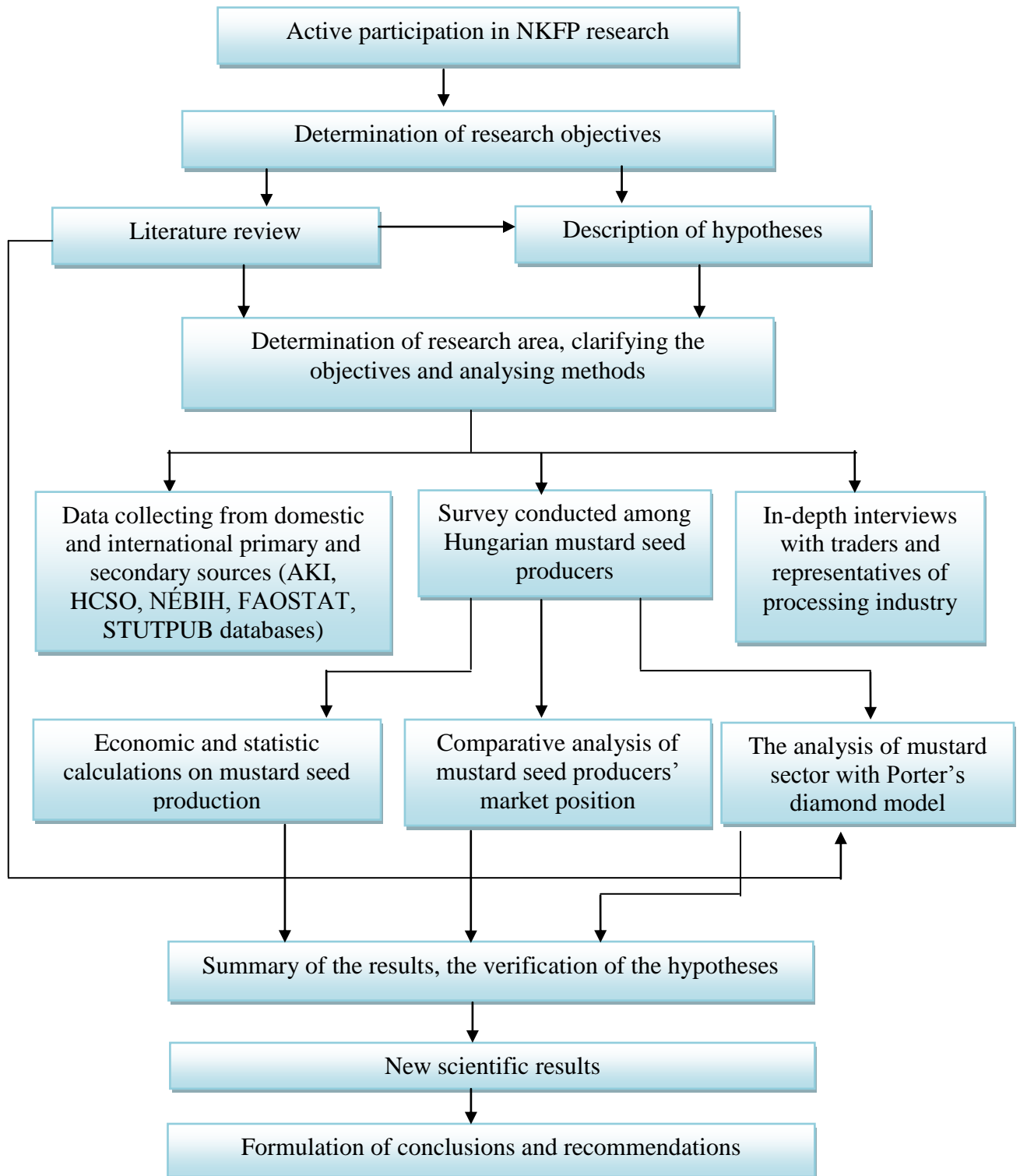

Figure 1: The flow chart of the PhD research
Source: own construction

1.3   Hypothesis of the research

In the beginning of my research, I formulated the following hypotheses:

Hypothesis 1 (H1) – The decrease of the production area of mustard seed is influenced by several uncertainties during the production period, such as:

> **H1a** – The yield level of the different mustard seed producers is rather low, with high deviation, which reduces the traders' and buyers' willingness for contracting.

> **H1b** – The profit level is very low in case of an average mustard seed yield, which reduces the motivation of producers of mustard seed production significantly.

> **H1c** – The price of mustard seed is strongly determined by the quality and the level of the domestic mustard seed production.

Hypothesis 2 (H2) – One of the most important reasons of low yields is that mustard is considered as third-rate crop in Hungary.

Hypothesis 3 (H3) – Those companies which are operated in the Hungarian food processing industry and use mustard seed products in their production processes, mostly use mustard seed which were produced in Hungary.

Hypothesis 4 (H4) – There is a potential in mustard seed production for improving profitability, both in the production value and the costs side.

Hypothesis 5 (H5) – The technology of mustard seed production may also be improved by which a more effective production may be performed by an optimized use of resources and optimized cost level.

Hypothesis 6 (H6) – The stability of mustard seed production may be improved significantly by improving the cooperation between the players of the mustard seed market.

2. MATERIAL AND METHOD

For fulfilling the objectives of my research program, in the first stage I made a comprehensive literature review based on **secondary data** of **international and Hungarian literature sources**. I also made a **comparison** between the different experiences and results of the different literature sources.

For the assessment and the analysis of the production, the utilization, the processing and trading conditions of the Hungarian and international mustard seed market is gathered and processed the information of the databases of **FAOSTAT** and **STATPUB** (market information and databases). For the analysis of the Hungarian mustard seed sector, is used the secondary database of FAOSTAT, the Hungarian Central Statistical Office (**HCSO**, with Hungarian abbreviation: KSH) and the **primary data** of the Farm Accountancy Data Network System prepared by Hungarian Research Institute of Agricultural Economics (**AKI**). I also used **secondary data** of the Quality Assurance Department of the Hungarian National Food Chain Safety Office (**NFCSO**, with Hungarian abbreviation: NÉBIH).

For the comparison of the different technology versions and for the economic **evaluation of the use of mustard seed as an alternative feeding stuff** I used the experimental results of

a formerly conducted NKFP (National Research & Development Programme) research, which I completed by cost estimations and different economic analyses.

For generating additional **primary data** for my research, I carried out a **survey for exploring the expectations and experiences of the Hungarian mustard seed producers**. My questionnaire focused on the motivations of the farmers for mustard seed production, their experiences and problems of the production, their marketing possibilities and contracts and their vision about the future of the mustard seed production on their farms.

Besides surveying the producers, I also made **a survey among the other players of the mustard seed market** (traders, integrators, and processing companies) for collecting **primary data**. I used the method of in-depth interviews by personal contacts or through telephone interviews. The primary aim of this survey was to explore the relations between the players of the mustard supply chain and to assess their bargaining power.

The objectives of my researches and thesis, the used data sources and the methods of their procession are detailed in Table 1.

Table 1: The objectives of the thesis, its data sources and the methods used

Objectives	Material	Method
1. Introduction of the international mustard seed market and Hungary's position at the export market	▪ Literature sources ▪ FAOSTAT, STATPUB, HCSO data	▪ Analysis of literature sources ▪ Comparative analysis
2. Determination of the minimum production size	▪ Hungarian FADN database 2007-2011	▪ Analysis of hedge chart
3. Determination of the effective technology versions	▪ Literature sources ▪ Questionnaire survey in 2004 and in 2013	▪ Analysis of literature sources ▪ Comparative analysis
4. Proposals for improving the coordination between the players of the Hungarian mustard sector	▪ Literature sources ▪ In-depth interviews with the important players of the Hungarian mustard sector	▪ Analysis of literature sources ▪ Comparative analysis
5. Assessment of the market position of the Hungarian mustard seed producers, and the economic evaluation of mustard seed production	▪ Questionnaire survey in 2004 and 2013 ▪ Hungarian FADN database 2007-2011	▪ Costs and income analysis ▪ Economic model calculations ▪ 2 Tailed T-test
6. Determination of influencing factors of yields and economic performance	▪ Hungarian FADN database 2009	▪ Statistical analysis (Cobb-Douglas function)
7. Industry analysis	▪ In-depth interviews with the players of the mustard seed market	▪ Porter's Diamond Model

Source: own construction

3. RESULTS

3.1 Economic analysis of mustard seed producers based on farm-level data

For the economic analysis of the mustard seed production I made my calculations based on the farm level data of mustard and canola production for the period between 2007 and 2011, on the courtesy of the Hungarian Research Institute of Agricultural Economics (AKI). I made gross margin calculations for both crops, and I conducted a comparative analysis for exploring the profitability of the most important fieldcrops (wheat, maize and canola). Finally, using a model function, I determined the break-even size of the mustard seed production.

By these economic calculations, my aim was to determine the costs and the total revenue of mustard seed production, and to conduct break-even calculations for this sector. From the available 5-year data series of the different mustard seed producing farms, I calculated the average costs and total revenue values, which has resulted the average cost and total revenue data per one hectare for the Hungarian mustard seed producer farms between 2007 and 2011. These data are summarized by Table 2.

Table 2: Average cost and total revenue data of Hungarian mustard seed producer farms between 2007-2011 (HUF/ha)

Description	2007	2008	2009	2010	2011
Total revenue (HUF/ha)	62 619	178 871	151 390	97 109	175 454
Average yield (t/ha)	**0,63**	**1**	**0,8**	**0,65**	**0,98**
Price (HUF/t)	**99 396**	**178 871**	**189 238**	**149 398**	**179 035**
Total direct variable costs (HUF/ha)	29 154	44 595	50 045	32 315	46 056
Total indirect variable costs (HUF/ha)	28 121	35 910	42 301	37 025	35 571
Wages and public contribution on wages (HUF/ha)	9 598	12 560	11 684	14 367	16 802
General costs (HUF/ha)	4 668	7 397	6 935	6 405	3 904
General costs of mustard seed production (HUF/ha)	664	2 353	1 536	773	884
Costs of maintanence activities (HUF/ha)	518	394	521	118	791
Direct governmental support (HUF/ha)	37 729	45 509	49 906	66 506	69 753

*Source: own calculations based on the primary data of the Hungarian FADN system
(AKI, 2007-2011)*

In the examined 5-year period, a significant fluctuation of the yields, price and machinery costs may be observed. The fluctuation of the yields may be resulted partly by the adverse weather conditions, but it is also caused by using the not appropriate technology. The hectic changes of the prices are influenced by external factors such as the international market conditions, particularly the Canadian yields and market prices.
The average price of land rent has doubled between 2007 and 2008, and since then it has been relatively stable. According to the data, it can be stated that 65% of the mustard seed producing farms rent the total area that is used for mustard seed production.
The direct support has increased continuously, by 65% between the initial year of the examined period (2007) until 2011. This increase has induced a very positive change in the mustard production in Hungary, because – as it was mentioned in the previous calculations – it has a strong compensating effect against yield decrease.

The costs, the income categories and the results of break-even analysis, which were calculated from the basic data of the 5-year period, are summarized in Table 3.

Table 3: Summarizing table of calculations of costs, income categories and break-even analysis (between 2007 and 2011)

Category	2007	2008	2009	2010	2011
Average yield (t/ha)	**0,63**	**1**	**0,8**	**0,65**	**0,98**
Break-even point (t/ha)	1,01	0,76	0,78	0,89	0,76
Break-even point with subsidies (t/ha)	0,63	0,61	0,58	0,53	0,54
Price (HUF/t)	99 396	178 871	189 238	149 398	179 035
Average costs (HUF/t) (without wages)	113 536	155 431	169 455	148 831	148 655
Average costs (HUF/t) (for total variable costs)	90 913	80 505	115 433	106 677	83 293
Net income (HUF/ha)	-37 808	41 966	4 142	-36 323	39 728
Net income with subsidies (HUF/ha)	-79	87 475	54 048	30 183	109 481

Source: own calculations based on the data of Table 3.

The amount of the break-even point with subsidies was between 0,53 and 0,63 tons per hectare in the examined period, which quantity is very close to the average yields (between 0,63 and 1,00 ton per hectare). The net income calculated without the support has produced losses for the average farm in 2007 and 2010, which implies that the increase of the subsidies can be a very positive external impact for the mustard seed sector and it represents a compensation function against the yield losses.

After the determination of the yearly results by the average data of Hungarian mustard seed producing farms, in order to explore the differences between the different farms, I calculated and evaluated the profit per unit of the mustard seed producing sector for each year.

When analysing the **profit per unit values** of the mustard seed producing sector, a significant deviation may be observed between the edge values of the quartiles. It may have different reasons: for example, the use of different technologies, the low input level and lower income level derived from low yields; while on the other hand, with better quality of soils a higher profit may be reached using more outputs and better technologies.

According to the edge values of lower quartile groups it can be stated that in the examined period – except in 2007 – more that 75% of the farms could generate profit, which should be considered as a positive result. It is also important to evaluate the edge values of the upper quartile group, which show the maximum value of the mustard seed production of the 75% of the farms. The best values (140-150 thousand HUF/hectares) were reacted by 25% of the mustard seed producers only in 2008 and 2011, which – in general terms – is not an outstanding result, but it refers to the hidden reserves of the sector.

For the evaluation of the income level of mustard seed production it is necessary to assess the income level of those fieldcrops which play important role in the domestic crop structure, namely wheat, maize and canola, which is a related species of mustard plant. For this comparison, I used the sector-specific data of the Hungarian Farm Accountancy Data Network system, which is collected and processed by the AKI.

Figure 2 illustrates the profit level of the different crops in the period between 2007 and 2011.
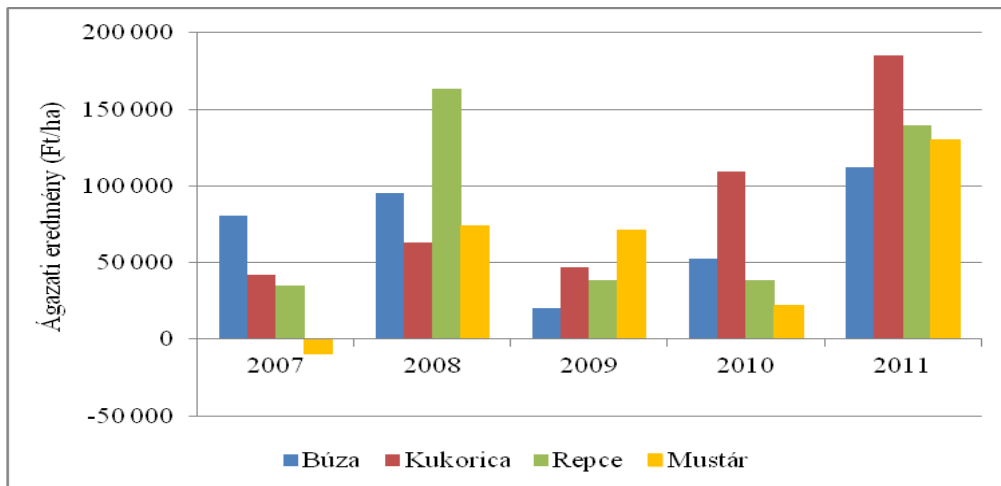

Figure 2: Profit level of different crop production branches (wheat, maize, canola and mustard) between 2007 and 2011

Source: Own construction on the data of Béládi and Kertész (2008, 2010, 2011, 2012)

The profit level of mustard seed production – except in the year of 2007 – is nearly at the same level than in case of the other crops. Its value exceeded the profit level of the maize in 2008, the wheat in 2011, while in 2009 the profit level of the mustard seed was higher than all examined crops. It justifies that the mustard seed production may be a good choice for the producers and its production may be as successful in financial terms as other field crops.

In my calculations for economic efficiency, I modelled the different cost and total revenue values for different sizes of production. The aim of defining my model was to determine the minimum size of mustard seed production. The linear **model function**, which was calculated by the farm level data is illustrated by Figure 3.
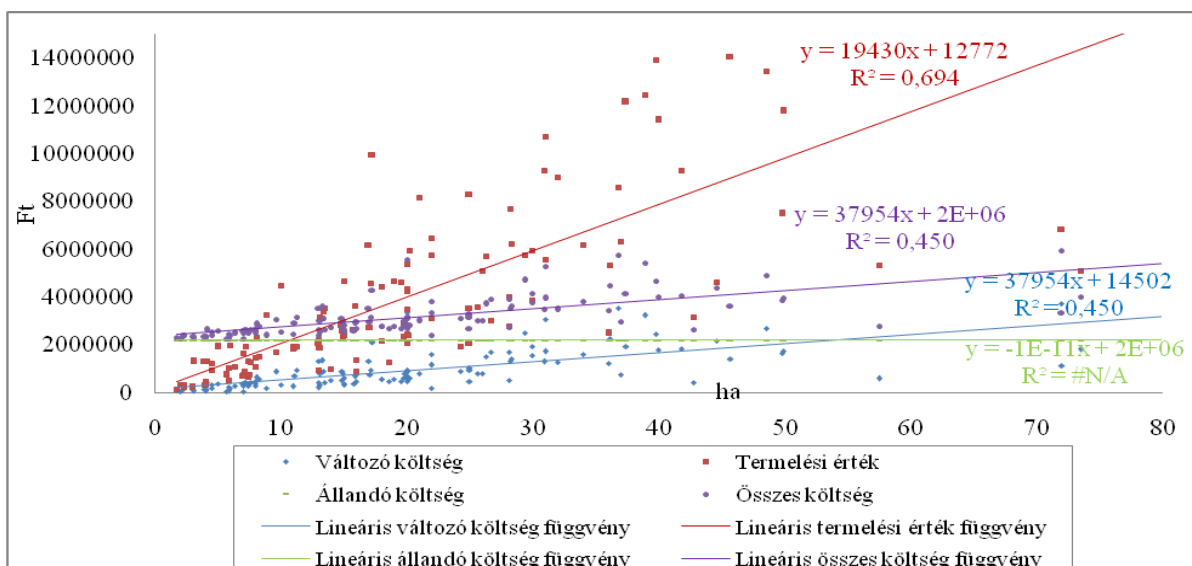

Figure 3: Modelled break even diagram of mustard seed production

Source: own calculations based on the primary farm level data of the Hungarian FADN system (AKI, 2007-2011)

The intersection of the linear total revenue and the linear total cost functions gives the break-even point of the mustard seed production, which projected place on the *x* axis the minimum size of production. According to my results, this size is 14 hectares. Actually, according to the FADN database 37% of the Hungarian mustard seed producing farms have not reached this minimum size of production in the examined years. However, only 27% of the farms were unprofitable in the examined five years, which shows that the size of production is just partly determines the profitability of the farms in mustard seed production.

3.2 Analysis of the impacts of changeable inputs of production

With my calculations, I analysed the changes in the mustard yield in case of different irrigation and nutrient supply levels and their effects on the cost level of mustard seed production. My objective was to show the hidden opportunities of mustard seed production, and to verify that there are significant differences between mustard seed varieties in the utilization of inputs.

I used the former NKFP research data for describing the changes in the mustard seed yields deriving from irrigation or nutrient supply. My cost calculations were calculated at present cost levels.

Impacts of irrigation on the mustard seed yields and production costs

In the irrigation experiments the Tilney variety reached the lowest increase in the yield (after four repetitions), which means 273 kg per ha when calculated according to farm level production. Therefore, I used this variety for my calculations for determining the surplus profit resulted by irrigation. The realizable surplus profit resulted by the different input prices in case of variety Tilney is summarized in Table 4.

Table 4: The surplus profit resulted by irrigation at different input and output price levels (variety: Tilney)

Cost of irrigation (HUF/ha)	Selling price (HUF/kg)						
	140	160	180	**200**	220	240	260
37 800	420	5 880	11 340	16 800	22 260	27 720	63 600
43 200	-4 980	480	5 940	11 400	16 860	22 320	58 200
48 600	-10 380	-4 920	540	6 000	11 460	16 920	52 800
54 000	-15 780	-10 320	-4 860	600	6 060	11 520	47 400
59 400	-21 180	-15 720	-10 260	-4 800	660	6 120	42 000
64 800	-26 580	-21 120	-15 660	-10 200	-4 740	720	6 180
70 200	-31 980	-26 520	-21 060	-15 600	-10 140	-4 680	780

Source: own calculation

From the data of this table it may be observed that the surplus profit is 600 HUF per hectares at the present input level (54 000 HUF/ha) and selling price (200 Ft/kg). According to the results of this experiment with the lowest yield increase level, we cannot realize a significant extra profit. On the contrary, if the selling price of mustard seed reaches 260 HUF per hectare, it may generate a 50 000 HUF extra profit.

The highest yield surplus (850 kg/ha) was produced by Ceska Zlata variety in this experiment, while the related farm-level increase reached an extra 595 kg/ha amount. Calculating by this surplus yield in the model, even at lowest price (140 HUF/kg) and highest irrigation cost (70 200 HUF/ha) a 13 000 HUF profit might be realized per hectare.

Based on the **model calculations** and using the basic data of the irrigation experiment it may be stated that in those farms, where the irrigation system has been already installed, a significant increase of profit may be reached in mustard seed production. In addition, other results of the experiment may verify that the different varieties react differently for irrigation. Therefore, it is very important to consider which variety is chosen, because by using such varieties which are able to produce higher yields, even 60 000 HUF per hectare extra profit may be realized at the present input and output price level. According to the results of the model calculations, with a well-chosen variety, irrigation may increase the profitability of the mustard seed production even in case of a 30% input price increase and 30% selling price decrease.

Impacts of different nutrient supply level on yields and production costs

In the NKFP research, three combinations of fertilizer doses were examined, in which the amount of nitrogen and phosphorous significantly exceeded the doses that is recommended by literature sources.

The results of the experiment verified the yield increasing impact of the higher nitrogen and phosphorous doses. The experimental results underlined that the different mustard varieties reacted differently on the different fertilizer doses. The average values of the yield increase of Budakalászi sárga variety were 1,62-1,73-1,83, while in case of variety Tilney the average results were 1,44-1,53-1,6. When calculating the experimental results into farm-level values, the Budakalászi sárga may reach 77 or 70 kg yield increase, while Tilney may reach 63 and 49 kg extra yield.

I conducted a sensitivity analysis for the Budakalászi sárga variety, which performed the highest yield increase. The results of my calculations are detailed in Table 5.

Table 5: Extra profit level resulted by extra fertilizer combination (N80 – P60) in case of Budakalászi sárga variety, at different input and selling price level

Price of extra fertilizer combination (HUF/ha)	Price (HUF/kg)						
	140	160	180	**200**	220	240	260
17 556	-6 776	-5 236	-3 696	-2 156	-616	924	2 464
20 064	-9 284	-7 744	-6 204	-4 664	-3 124	-1 584	-44
22 572	-11 792	-10 252	-8 712	-7 172	-5 632	-4 092	-2 552
25 080	-14 300	-12 760	-11 220	-9 680	-8 140	-6 600	-5 060
27 588	-16 808	-15 268	-13 728	-12 188	-10 648	-9 108	-7 568
30 096	-19 316	-17 776	-16 236	-14 696	-13 156	-11 616	-10 076
35 112	-24 332	-22 792	-21 252	-19 712	-18 172	-16 632	-15 092

Source: own calculation

Based on the results of my model calculations, it can be stated that at present fertilizer prices and present selling prices with the combination of 80 kg N and 60 kg P doses the surplus costs

will not be covered even by using the Budalkalászi sárga variety, which performed the highest yield level. Because the additional extra doses have decreased the amount of extra yield in the experiment, I did not perform additional calculations.

3.3 Examination of factors determining the yield and the performance of the sector using Cobb-Douglas function

For recognizing the factors that may influence the mustard yield I used the AKI database. I inserted a Cobb-Douglas function – which may be used for verification of the relations between the different factors – at the database of 2009, in which year the largest number of farms were represented.

The model showed very weak, but detectable connections between the **soil quality**, the **fertilizer doses** and **pesticide costs**. According to this result, it may be assumed that the higher fertilizer and pesticide costs per hectare will cause higher yields or better quality that may improve the production level.

At the next step, I analysed the role of the different factors in the yield increase. According to the model, the most significant factors were soil quality ((32,59%), fertilizer costs (23,42%), pesticide costs (19,26%), and the role of N doses (15,31%). I also conducted a variance analysis, which pointed out that the explaining power of the model is not strong enough.

I also determined those factors that may **influence the profitability** of the sector. The most important factors were the size of the farms, the revenues, yield level, selling price, cost of chemicals, machinery costs, the doses of nitrogen, the costs per unit and the total costs. The values of exponents are summarized in Table 6.

Table 6: The exponents of the Cobb-Douglas function and of factors determining the performance of the Hungarian mustard seed sector

Factors	Exponents
x_1 (Farm size)	0
x_2 (Average yield)	**1,8440**
x_3 (Price)	**0,4379**
x_4 (Fertilizer costs)	0
x_5 (Pesticide costs)	**0,1872**
x_6 (Machinery costs)	0
x_7 (Total costs)	0
x_8 (Nitrogen)	0
x_9 (Average cost)	0
x_{10} (Income)	**0,1890**

Source: own calculation

Examining the exponents of the function, it may be stated that the strongest influence might be observed in case of yields, because a 1% increase of yield will cause an increase in the performance of the sector (by 1,84%). According to the function, the additional influencing factors were selling prices, chemical costs and revenues.

As a summary, by using the Cobb-Douglas functions I verified that the most important influencing factor of the mustard seed producing sector is yield level ($R^2 = 76,64\%$). It means that the most important task in order to improve profitability of the mustard seed producing sector is increasing the yields.

3.4   Comparative analysis of mustard seed producing farms

After determining those factors, which may influence the yields and the financial performance of the sector, I analysed the production data of those mustard seed producing farms, which provided data in 2009. The production data of the different farms were conducted according to different factors: yield, revenue, farm-level profit and total costs. The **main objective of this analysis** was to compare the production data of the different farms, which were ranked into quartile groups. I focused on those farms, which were ranked into the lower and upper quartile groups. With this analysis, I wished to verify that those farms, where the input level is higher and higher fertilizer, pesticide and machinery costs can be found, may reach higher yields and the additional inputs and extra costs may be recovered by the value of the yield surplus.

By the **results of the 2-tailed T-test**, in case of variables of farm **profit level, revenues and total costs**, a significant difference was detected between the average values of the lower and upper quartile group **distinguished by the yield variable**. It means that those farms, which have reached the highest yields, worked with higher cost level, and they could reach better profit level than those who were ranked in the lower quartile groups according to the yield level. In case of the variable of farm **profit**, there were a significant difference between the variables of revenues, yield, selling price and costs per unit. Therefore, those farms which have reached higher profit, they could reach significantly higher yields and selling price, thus, their revenues were much higher.

The results of my calculations have verified that the higher input level will increase the yield and through the higher yield level, the farms may realize a higher profit. This result may also justify that there are additional hidden opportunities in the mustard seed production.

3.5   Questionnaire survey of mustard seed producers

I conducted a questionnaire survey among mustard seed producers in 2004, which I repeated in 2013, through a personal interview with the leaders of 90 mustard seed producing farms. In the questionnaire, I focused on the motivations of the producers, the possible problems of production, the trading channels, the production contracts and the future possibilities of the sector. The results of my survey emphasized that mustard is considered as a third-rate crop, and the most important objective of the producers during the production process is cost-minimising. The **most important problems of the sector** are the low yields, the low profitability, the uncertain prices and trading opportunities.

According to their motivations, the farmers could be divided into two groups. In the first group, those farmers were classified who make their decision about the size of the mustard seed area of the given year, based on technology (**crop rotation**). The other important aspects of motivation were marketing opportunities, the **selling price** of mustard seed and the possibilities for **production contracts**. An additional important factor of farmers' motivations was the possible selling price of other, more important crops such as wheat, maize, barley or sunflower.

When analysing the production contracts, it can be stated that seed production is realized only through production contracts, while in case of mustard production for industrial use there are many immediate buying and selling contracts. As the **contracts** are given in terms of **area**, the lower yields will not cause any problems for the farmers. On the contrary, lower quality parameters main raise problems for the farmers, because lower quality will be manifested in lower selling prices. In case of mustard seed produced for the food industry, the **quality**

parameters may be differentiated according to the use of mustard seed, or the quality requirements of the processing plants.

The producers have low bargaining power through the contracting process, the farmers have price-taking attitude. The prices given by the traders are in compliance with the need of the foreign traders. Besides the yield level, the profitability of mustard seed production is highly influenced by the changes in the selling price. As the price is an external factor of the market and it depends on the Canadian yield amount, it shall be considered as an unchangeable factor at the domestic market. Because prices are unpredictable and therefore the possible profit will also be unforeseen, it significantly decreases the motivation for mustard seed production.

Summarizing, the problems of mustard seed production may be classified into two main groups: the first is connected to economic problems; the second is covering problems, which are determined by technology and weather conditions. The most important factor is **uncertainty**, and the fluctuation of the prices. In 2004, there was an overproduction in Hungary because of the great number of producers, which resulted lower prices. After these years, when the profits were rather low, the producers have lost their motivation for mustard seed production, which resulted the dramatic decrease of mustard seed producing area.

The other problem is connected to production **technology** and sustainability concepts. Despite the technology of mustard seed production is the same as used in canola production, it may raise problems for the producers. The attitudes towards mustard seed production are often having a negative tone, i.e. mustard is considered as so-called third-rate crop, and the producers prefer the production of more important field crops because of the poor marketing possibilities and lower yields of mustard seed production.

3.6   Economic evaluation of mustard seed, as an alternative feeding stuff

The dependence on the international market is one of the largest problems of the Hungarian mustard sector. The high Canadian yields decrease the demand for the domestically produced mustard seed, which influences the producers attitude for production in a negative way.

One of the solutions may be the storage of mustard seed. In case of low selling price level, the mustard seed can be stored for 2-3 years and it may be sold later, under more favourable conditions.

Another possible solution may be the formation of a well-established domestic market, which might improve the motivation of mustard seed production. Besides using seed for sowing and the industrial use, there are **alternative using directions** of mustard seed utilization, which may serve as a new market niche.

In the former NKFP research, the use of mustard as a substitute product of protein feeding stuff was explored. According to the research results, the mustard may substitute the protein content of feeding stuff even by 10-15%, therefore it can be used as an **alternative feeding stuff.**

In order to make a comparison between the different prices of mustard seed, I analysed the Hungarian selling prices in 2004. Based on the FAOSTAT database an average of selling prices were calculated with 56 HUF/kg. After the comparison of the prices, it may be observed that after the decrease of export markets the mustard seed may remain a potential of marketing and an alternative way of utilization. For the animal producers mustard seed may be a new source of feeding stuff and may be used as a cost saving input.

3.7   The analysis of mustard sector by Porter's diamond model

For the assessment of the mustard sector, I used Porter's diamond model. The factors of this model, which may determine the sector are: resource availability, demand conditions, the structure of the industry, the related industries, the role of economic policy and unpredictable phenomena.

According to the available resources, the domestic environmental and climatic conditions are quite good for mustard seed production. This crop may be produced in poor quality of soils, but in case of better quality soils, the yields will be much higher. Mustard seed production does not require any special resources; its technology is similar to the technology of canola production. There is a lack of varieties of mustard seed, the breeding process should be improved, which also may increase the competitiveness of the sector.

The domestic demand level is largely influenced by the export needs. A great share of the domestic production is seed production for sowing which destination is the export market. The mustard seed production for food processing industry represents a smaller proportion, but it has also an important share at the market. Another possible direction of use is green manure production. The quantity of mustard seed for industrial use may be influenced by the higher selling prices.

I also made an industry analysis, by Porter's five forces model.

The main objective of the Hungarian mustard seed production primarily is the seed production to be used in as seed for sowing, and in a smaller extent, as a raw material of the processing industry. Mustard seed is produced for export; the producers are in direct connections with the exporter or integrator organizations. The processing of mustard seed is made by only domestic companies, producers' connections are made directly with wholesalers and integrators.

Analysing the mustard seed market the bargaining power can be summarized as follows:
Suppliers of the mustard seed production are seed producers, fertilizer and pesticide producers and machinery manufacturers. The suppliers market is concentrated and they have well differentiated products, which may increase their bargaining power. Producers have only limited information about their products, which can decrease the bargaining power of the producers. The competition between suppliers groups is represented by mostly the competition of the products; the competition of prices cannot be dominant as a result of the relatively poor financial situation of Hungarian agricultural enterprises.

On the other side of the Porter model, producers have connections with the representatives of **buyers**; in the mustard sector buyers are represented by the integrator companies, wholesalers and traders. The producers' bargaining power is very low in these relations; they are mostly in price-taking situation, which means they should accept the prices offered by the buyers. When the producer does not accept the price, the contract will not be signed. In some cases, the producers can bargain for a higher price, but this is not a common situation. Prices are strongly determined by the EU market.

The bargaining power between the primary and secondary processing is more complex. The competition in the. The intensity of the price competition between the retailer companies is increasing, which affects directly supplier prices. The tendering of the suppliers is a widely accepted method, which is based on the prices, ant the compliance with the quality and food safety requirements. The higher is the quality assurance of the suppliers the higher is their bargaining power. The bargaining power between the **producers and the primary processing companies** is based on the fluctuation of the yields and the forced sales due to the

financial problems, which is a common and widely known situation in the agricultural sector. Consequently, the bargaining power of the mustard seed producers is very low.

Substitute products of mustard seed production can be divided into two main groups. First is cereal production, which competes for the arable land, as most important natural resource of mustard seed production. Cereal production has more advantages in the present circumstances and price and income situation, further improving the cereals market will increase the competitiveness of the cereal sector. Mustard seed is a raw material of different food products, for example mustard, mayonnaise, different sauces and salad dressings. These products are associated products of meat and salad consumption, therefore by increasing of the consumption of these products may bring the increase of the demand for mustard products.

The threat of **new entrants** are relatively low in the mustard seed sector, the technology and the machinery are the same as in the cereal production, so there is no need for special knowledge or technologies. As mustard can be grown either in less quality soils, therefore good soils can be used for other field crops. The only significant threat of entrants is selling, which may cause many problems for the producers, as it is very hard to get good contracts in appropriate time, because of the unstable prices and the uncertain yields. In case of not fulfilled contracts, the producers must pay penalty.

The **competition** between producers is very intensive and it is manifested in price competition. The price competition could be decreased by the concentration of the market, the cooperation of the supply chain and by establishing of long-term supplier contracts and sales contacts.

The vertical integration is not typical in this sector, particularly in the connection of the producers and the companies working in primary processing. There are special cases for **vertical integration**, where the enterprise takes part simultaneously in the primary and the secondary processing when producing mustard cream, mayonnaise and sauce products as well.

There are not such **organizations** in Hungary that may give **professional support** for the players of the mustard sector. During the survey, none of the respondents mentioned the possibility of taking part in education, or professional trainings. The lack of these services may be one of the reasons of the general lack of information, and the relatively low professional knowledge of the producers. According to the traders, producers make many mistakes during their decisions connected to the production; they use not appropriate technology, which increase the risk of market failures.

The **informational background** of the mustard sector is very poor, the Hungarian Central Statistical Office (HCSO) has only very few data about the mustard sector. In order to improve the competitiveness of the Hungarian mustard sector it is essential to establish a supporting institutional background for providing information for the producers and to conduct professional trainings and knowledge sharing possibilities for them. Without these steps and without coordination the Hungarian mustard sector cannot be successful

Figure 4 summarizes the distribution channels of the mustard seed sector and the complex scheme and the different directions between the different participants.
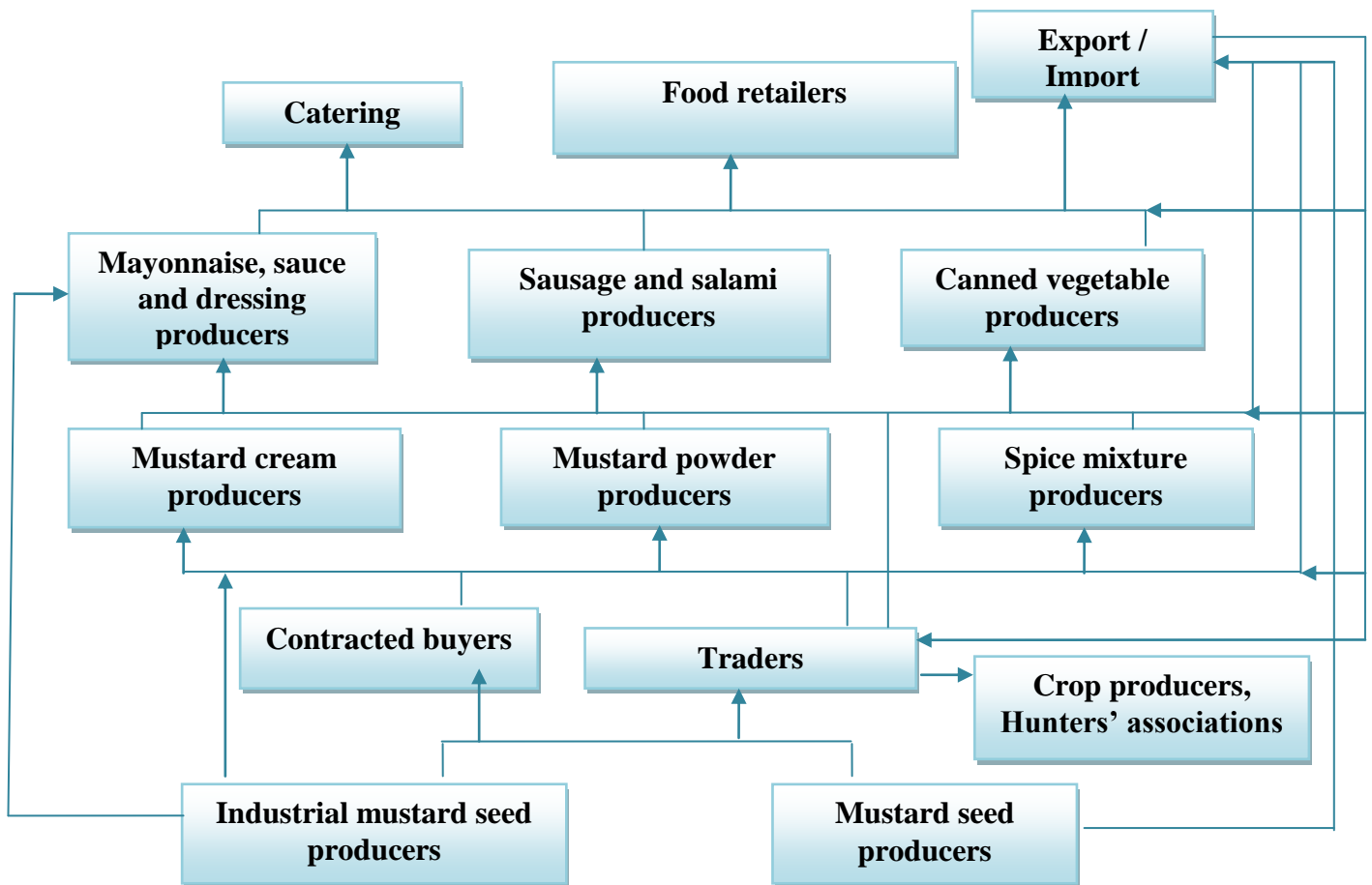
Figure 4: The distribution channels of mustard seed

Source: own construction

When examining the **distribution system** of the Hungarian mustard sector, it can be stated that the production is based mostly on mustard seed production, while the production for industrial use it is rather low, it is represented by only a few producers, who produce directly for the mustard processing industry. The mustard powder and mustard cream producers and the processing companies use mostly imported raw materials for mustard production. The greatest share of the produced mustard seed is for export, the producers have direct connections with the integrators and the traders.

4. NEW SCIENTIFIC RESULTS

1. **I made a complex assessment of the Hungarian and international mustard seed production and trading conditions by a system approach, based on primary and secondary data.**

   In the literature review of my dissertation, I dealt with the main production and trading data of the most important mustard seed producing countries. I focused on our closest competitors, Canada and the Czech Republic. I analysed Hungary's mustard seed sector even from the 1980s. In the domestic and international literature, there is no such a comprehensive report about mustard seed production.

2. **In my researches, I explored the different connections and the market position of mustard sector. I also assessed the relations between the main players of the mustard seed production, and finally, I determined the market position.**

   Using Porter's diamond model, I explored the differences between the interactions of the players of the sector; I also determined their real bargaining power and the uncertainties of mustard seed sector.

3. **I analysed the cost-benefit data of mustard seed production based on the farm level data of the Hungarian FADN system between 2007 and 2011. With my calculations, I verified that there are significant differences between the lower and upper quartile groups, which were ranked according to their mustard yield and profit level. I also explored the reasons of this situation.**

   Based on the cost and income calculations I determined the profitability of mustard seed production and the break-even point with subsidies. Based on secondary data, I made a comparative analysis of mustard seed production and the production of the most important field crops on their profitability.

4. **Using the primary data of the Hungarian FADN system in the year of 2009, I conducted a regression analysis using the Cobb-Douglas function. By these calculations, I determined the different factors that may influence the yield level and the performance of the mustard seed producing branch.**

   Based on the analysis of the 2009 years' data, I verified that the yield level is strongly determines the performance of the sector, while its additional important factors were soil quality, the costs of fertilizers and pesticides.

5. **In case of different varieties of mustard, I verified by model calculations that certain changeable resources (i.e. irrigation water, fertilizers) have significant economic impacts in mustard seed production. I also emphasized the importance of technology improvements in order to use the hidden opportunities of the mustard seed producing sector.**

   I examined the influencing effects of irrigation and nutrient supply by different doses of nitrogen and phosphorous on the yield of mustard seed. In the economic analysis, I calculated the extra costs of the surplus revenues, and the impacts of additional inputs on the farm level income.

5. CONCLUSIONS, RECOMMENDATIONS

Summarizing the scientific results of my dissertation, I start with the verification or failure of my hypotheses, then I introduce my conclusions and finally I propose my recommendations focusing on improving of the competitiveness of the mustard seed sector.

H1 hypothesis and its sub-hypotheses (**H1a** and **H1b)** were **verified,** because the results of the questionnaire survey and the analyses conducted by the farm-level data of the AKI have proved that the mustard seed yields are very low, with a significant standard deviation. Although the Hungarian data of mustard yield provided by the FAOSTAT database should be considered as average, I shall state that the low Hungarian mustard seed production are due to low yield levels. The uncertainty of production is very high. There are main questions about uncertainty, for example low marketing possibilities, selling prices and yield level. These factors strongly determine the decreasing trend of motivations for mustard seed production. My **H1c sub-hypotheses** were partially verified, because the selling price of mustard is influenced by two factors: the Canadian yield level, and the quality of the product. Quality may influence the selling prices and the requirements given in the production contracts.

H2 hypothesis was also **verified**. One of the reasons of low yields is the position of mustard seed as a third rate crop. In my opinion, its reasons are rooted in using non-appropriate technologies and technical solutions and the extremely low use of inputs, and of course the unfavoured weather conditions.

H3 hypothesis is **failed**, because based on the results of the in-depth interviews, it can be stated that a large share of the mustard seed used by the domestic processing industry is imported, as the demand of the food industry increased in the recent years and the domestic producers were not able to satisfy its demand.

H4 hypothesis was **partially verified,** because in my opinion the increase of profitability of the sector may only be solved by an overall technology improvement and the increase of the yields. The cost saving shall not be a future objective, as at the present, the Hungarian mustard seed production is operated with a minimum cost level, which was justified both by my calculations based on the farm level data and by the results of my survey.

H5 was **verified**, because the examination of the factors which may influence the average yield level and the performance of the sector – conducted by Cobb-Douglas functions – have proven that improving the profitability of the production may be achieved by optimized inputs and the presently used technologies have many hidden opportunities for this improvement process.

H6 hypotheses was also **verified**, because many of the external and internal factors of the domestic mustard seed market have a negative influence on the players of the market and their marketing opportunities. The mustard seed market should be stabilized by the coordination of the different players of the market.
Despite the former export activities, the mustard could not be considered as a preferred crop. One of the **main problems** is the **fluctuating market conditions** and the continuopusly **changing prices**, which determines basically the motivation of the producers. The demand of the Eastern European market is strongly determined by the supply of the Western European and Canadian yields, but Ukrainian production has also a strong influence on the market. These factors have a very strong effect on the producing attitudes of the farmers and the cyclic features of the total amount of mustard production. The motivations of the domestic producers are strongly influenced by the predictable prices of other crops (wheat, maize,

sunflower), because the marketing conditions of these crops are much better than in case of mustard seed. According to the results of my in-depth interviews, at the present the foreign prices of mustard seed are moving towards the price level of other crops, which may improve the present situation and the motivation of the producers.

My conclusions and recommendations for improving the competitiveness of the Hungarian mustard seed sector are the following:

- establishing and improving the coordination between the players of the mustard seed market,
- improving the mustard seed production for sowing, finding new markets,
- governmental support for improving the market conditions,
- improving the motivation of producers towards the production of alternative crops,
- better communication for improving the production technology and optimized input use (varieties, irrigation, nutrient supply) in order to increase yields,
- increasing the proportion of domestically produced mustard instead of the presently high import level,
- increase the use of green manure and improve the communication about its advantages,
- supporting the alternative use of mustard seed and mustard crop, improving storage capacities.

The present production structure is a largely unmanaged structure with **high management and transaction costs,** which decrease profitability significantly. By the coordination of the sector these costs may be decreased which may improve the competitiveness of the mustard seed sector. The domestic producers are not able to regain the former export markets; therefore it is **inevitable to establish a coordinating body** at least at traders' level.

The **importance of production technology and the role of inputs** that influence the production level **should also be communicated** better. By the results of the researches, the effect of additional resources has been verified, and I also justified that the **variety has a strong influence** on the production, because the different varieties will react differently on the level of nutrient supply and irrigation water. These factors may also improve profitability and the competitiveness of the sector.

The demand of the **domestic processing industry** should be fulfilled by domestic production, which could improve the market position of the domestic producers, but it could also improve the safer supply of the processing industry. The importance of using green manures should also be communicated better, because by this the domestic production may also be stabilized.

In my conclusions and recommendations, I **highlighted** the hidden potentials of domestic mustard seed production and export opportunities, by which the sector could be developed and its competitiveness may be improved.

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