ECONOMIC MODELLING AND ANALYSIS OF HUNGARIAN WHEAT PRODUCTION IN THE MARKETING YEAR 2011

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Abstract: In the framework of the present study I analysed the wheat production sector. In order to evaluate the situation prevailing in the sector I conducted an economic analysis which I based on primary data collection. The year of investigation was the production year of 2011. Long-term implications for different crop sectors can only be based on multi-annual analysis, so in this article I only attempted to analyse the sector with respect to 2011. To evaluate wheat production I compiled its cost structure and assessed it. To evaluate its position in comparison to other crops I also carried out calculations to determine the gross margin (revenue minus variable cost)[1] By gross margin I mean the gross margin (C), which is production value (PV) minus direct cost (DC), by definition (C=P-DC).
 of maize and rape. I observed that the gross margin attainable on one hectare was the lowest in the case of wheat. I applied two types of gross margin, because I consider it important that a given sector should also be profitable without subsidies. In the case of the gross margin including subsidies it is essential to emphasize the role of subsidies, since their ratio varied between 30 and 47% of the total revenue. The importance of subsidies was the most significant in the case of winter wheat.

Keywords: plant production, wheat, cost structure, analyses.

1. Introduction

"The importance of wheat production in the world economy is proven by its share of 15% of the 1500 million hectares of the world's arable land. This rate is equivalent to an area of 225 million hectares of wheat, based on FAO figures for 2009" (KISS, 2011). Among cereal crops wheat makes up the largest proportion. There are minimal differences in the case of the sowing area in different years. In 2009 wheat was produced on 225 million hectares around the world, of which the proportion provided by the ten countries occupying the largest harvested area is 71.3 %, which is equivalent to 160.6 million hectares.

In the year 2009 681 million tons of wheat was produced, of which the top 10 countries produced 69.6%. 659.8 million tons of wheat was consumed. 69.8% of the total consumption was used for food supply, 18.5% was used for feed, while the remaining 11.5% was used for other purposes. In the ranking of the leading wheat growers in the world the participants have remained the same apart from a minimal deviation in the period between 2000 and 2009. Only two large wheat producing countries (USA and Russia) changed places in the ranking in certain years in the given period. Between 2003 and 2008 the USA was the third largest wheat producing

country in the world, while Russia reached third place in terms of predicted production in 2009. The rankings of the above-mentioned two countries were also noteworthy in 2010, since a significant yield decrease occurred in both countries due to unusual weather conditions (FAO, 2010). There was a slight increase in the annual crop yield between 1990 and 2009, due not to the increasing sowing area, but to the slow and successive increase in the average yield. An annual average of 2.5 tons wheat was produced on one hectare of crop land in the world in the first half of the 1990s; however this reached about 3 tons in 2009.

In 2008 139.1 million tons wheat was traded worldwide, 39.7% of which went to the ten largest wheat importer countries of the world. From Hungary's point of view it is important to highlight that three out of the ten largest wheat importer countries are EU member states, which might be considered market outlets for raw materials. In 2008 81.4% of the total traded wheat came from the ten largest wheat exporter countries of the world. Consequently, it can be stated that the concentration described above in the case of wheat production is even more characteristic when considering the international wheat trade. There are minimal differences in the ranking of the top ten countries in the different years. Between 2000 and 2008 the United States was the world's largest wheat exporter each year.

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[1] By gross margin I mean the gross margin (C), which is production value (PV) minus direct cost (DC), by definition (C=P-DC).

The European Union produced 138.7 million tons of wheat in 2009 and the first ten countries within the EU produced 86% of this amount. France is the biggest wheat-producer in the EU, producing 38 million tons of wheat in 2009. Germany remains in second place with a production of 25 million tons. The UK is the third with 14 million tons. In the rankings of the world's top wheat producing countries France and Germany are in the top 10.

Figure 1 illustrates the structure of agricultural land in Hungary. Hungary has 4.5 million hectares of arable land. The proportion of Hungarian arable land sown with cereals fluctuated between 68.4% and 69.9% in the period between 2004 and 2008. The differences between the different years are negligible. Within the cereal category the importance of wheat and corn is almost the same. Both crops cover approximately 28% of the entire arable land (KSH[2] Hungarian Central Statistical Office (abbreviation: KSH), 2011). In 2009, Hungary, with 1.15 million hectares devoted to wheat production, was 29th in the world ranking. Minimal differences can be observed regarding the area under wheat in Hungary during this period. The area in Hungary sown with wheat decreased both in 2010 and 2011, as compared to 2009, for various reasons related to growers. The profitability of wheat production was low in 2009, and as a consequence a number of growers decided to change the sowing structure to the detriment of the wheat sowing area. During the sowing period in the autumn of 2010 there were negative meteorological conditions together with ground water problems and therefore a number of growers could not sow wheat on the areas previously intended. In summary, it must be stated that both in 2010 and 2011 the area under wheat decreased in Hungary as compared to 2009; however, there were completely different reasons for the decrease in the two years. In 2010 the profitability of wheat could be considered satisfactory.
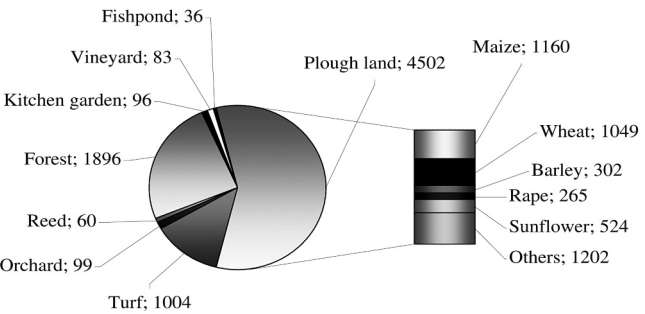

Figure 1: Structure of agricultural land in Hungary and the sowing area structure of crops in 2010 (in thousand hectares)
Source: KSH, 2011

2. Objectives, Materials and Methods

I determined my objectives as follows:
- To construct an integrated system featuring the factors influencing the profitability of winter wheat production, and to illustrate the system graphically.

- To briefly present the direct cost structure of wheat production and the possibilities for cost reduction.
- To compare the revenue, production value, direct cost and gross margin of winter wheat with the relevant values for rape and maize.
- To produce a scenario analysis of the profitability of wheat production according to the selling prices and the specific yields ceteris paribus.

I conducted primary data collection on two family farms in Eastern Hungary, one of which is located in Borsod-Abaúj-Zemplén county, the other in Békés county. I consider these two farms to be typical Hungarian family farms. The two farms examined farm an area which is almost the largest legally possible and their workforce is many times more than the family members. I visited the farms to collect the input data and technology information to conduct model calculations. I collected data on subsidies, production technology and for expenditure I collected data on physical inputs and their unit prices. I collected data for the period between September 2010 and September 2011. In the calculations I applied parametric cost estimation. Firstly I calculated the direct cost of wheat production, in which I took into account the machinery operation costs on the basis of the catalogue of the farm machinery services (GOCKLER, 2010 and 2011). I made sure to calculate with appropriate prices, thus obtaining the annual price when the task was completed. In the catalogue of farm machinery services the service providers also include the labour costs related to machine operation. Since we study family farms, ignoring the work carried out by the farm owners would distort the result of the cost calculation. Consequently, in my calculations the machinery operation costs also include labour costs, calculated on the basis of the catalogue prices. Furthermore, machinery operation costs include the material costs related to machinery operation and maintenance and the obligatory insurance fees for the machines. Depreciation costs were collected separately during the farm visits, thus they are not included in the machinery costs. In my opinion this allows us to avoid cost distortions in the calculation. In the case of physical input costs I based my calculations on the unit price information given by the farms. I used the per hectare depreciation rate applied by the farms. I compiled the direct cost structure of the winter wheat production and then evaluated it.

Figure 2 demonstrates the logical framework of the model used for the calculation. The model carries out the calculations necessary for parametric cost estimation and for computing sales revenue, production value and gross margin.

The results of the calculations appear on the output side of the model in a form that allows them to be used to make the analysis.

Figure 2: Logical framework of the model used for the calculation
Source: Author's own editing, 2011

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[2] Hungarian Central Statistical Office (abbreviation: KSH)

To determine the production value I used the production yields realized in 2011 where they were available; where the harvest was still underway (maize) I used the projections of the MgSzH (Central Agricultural Office). I used the prices reported by the AKI PÁIR (Research Institute of Agricultural Economics, Market Price Information System) at harvest time. Accordingly, for rape and wheat I used the average prices recorded in July, 2011, and for maize the average price in September, 2011. Having obtained the prices I computed the revenue per hectare in the given production year. The subsidies are part of the production value, so the amount of subsidies reported by the farms was included in the calculation. In our case subsidies cover area based payments and gasoline subsidies. Within area based payment I took into account only the sum of the ordinary SAPS received in 2010, and excluded possible involvement in agri-environmental measures. Concerning gasoline subsidies I applied the maximum per hectare payment that is legally possible.

After computing the production values and the direct costs I determined the attainable gross margin per hectare for each plant for the production year of 2011. I calculated two versions of gross margin, because I consider it important that a given sector should be profitable without subsidies. Therefore, I calculated the gross margin with and without subsidies.

Finally I conducted the scenario analysis of the gross margin (ceteris paribus) of the wheat production sector, in which the costs previously calculated and the subsidies were taken in account. Since the national average values are not valid for all the farms, the need for such an analysis is

justified. In my view there is no need to explain the possible differences between the average yields realised in the two farms. We can obtain a more realistic picture of the given crop sector through the scenario analysis of the gross margin with altering yields and selling prices. That is, I applied different specific yields and different selling prices when conducting the analysis. The different values of specific yields and selling prices were determined using the many years of professional experience of the members of the given farms and also taking into account the genetic potential of the crop. I conducted the scenario analysis with two types of gross margin: one that involves the subsidies, and one that does not.

3. Results and Discussion

3.1. Demonstration of the factors influencing the profitability of winter wheat production

3.2. Direct cost structure of wheat production in 2011

Figure 4 illustrates the direct cost structure of winter wheat production. The cost structure involves the following cost elements: machinery cost, material costs, depreciation and insurance. As mentioned above, machinery cost also includes labour cost, since I applied the prices given in the catalogue of the farm machinery services, in which the labour cost of the machine operators is included. As a consequence, machinery cost accounts for 48% of the total cost.

The share of the other significant cost group (material cost) is 46%. Pesticides, fertilizers and seeds belong to this group. Since the yields of crop production are mostly defined by the amount of nutritive matter, one should not decrease the amount of nutrients just to decrease the costs. However, artificial fertilizer is not the only solution to ensure nutrient supply to the soil, and it is worth applying other types of fertilization during the production process. In my opinion supplying nutrients through manure might result in a significant reduction of artificial fertilizer. On the other hand, appropriate use of manure might contribute not only to cost efficient and profitable production, but also to maintaining environmental balance. Other possible methods to decrease fertilizer requirements are organic manure, industrial by-products (e.g. sewage-sludge), and using papilionaceae plants as a green crop. Although these methods cannot provide for the total nutritional requirements of the soil, they can significantly decrease the need for artificial fertilizers. Accordingly, where they are applicable one should not avoid using them.

Pesticides constitute the other important subgroup within the category of material costs. From the viewpoint of cost reduction the possibilities are very limited. Evidently, one can avoid using expensive chemicals by applying other substitutive matters.
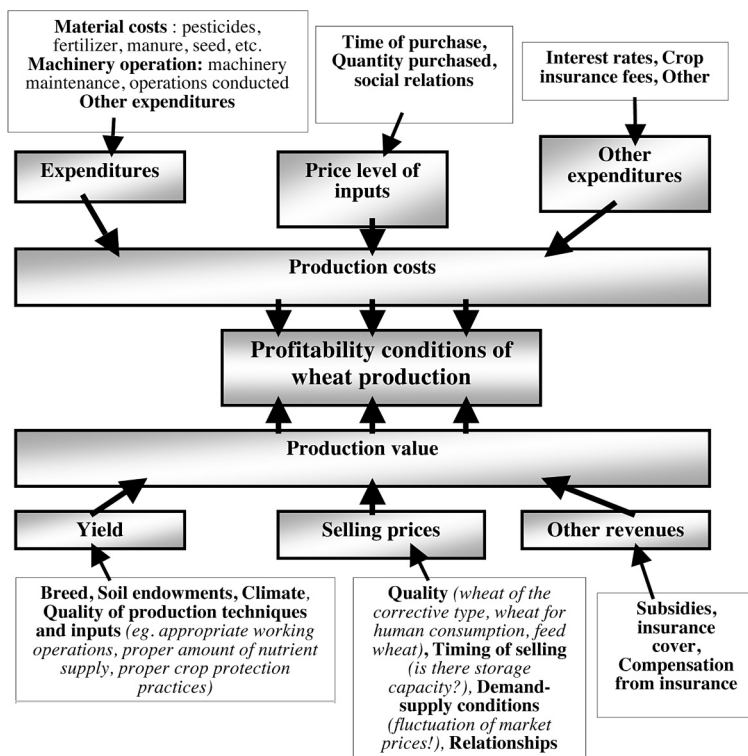

Figure 3: System of the factors influencing the profitability of wheat production
Source: Author's own editing, 2011

Obtaining pesticides from more suppliers might result in cost reduction, however more suppliers mean greater risk and smaller order size means weaker bargaining power. At the same time when buying from more suppliers (assuming there is no cartel) the competition between the suppliers might push down the prices. Furthermore, the enterprise can have a broader outlook on the market prices. However, this observation is valid for all the input materials.
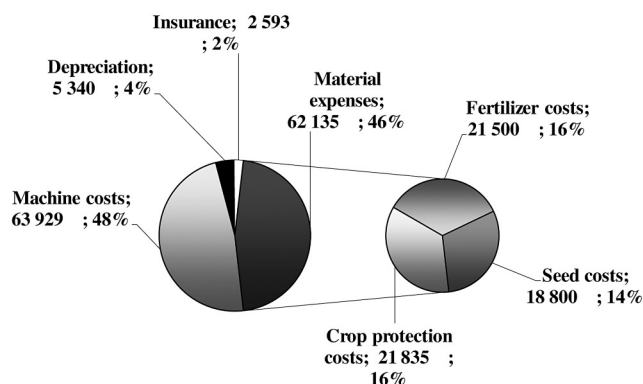

Figure 4: The direct cost structure of winter wheat production (Ft/ha; percentage; total: 133 997 Ft/ha)
Source: Author's own calculation and editing, 2011

The third subgroup consists of the seeds. This subgroup represents the smallest share within the cost structure, but its role should not be underestimated. Inappropriate choice of seed might undermine the production process, thus significant emphasis should be placed on it. The cost reduction methods described in the case of pesticides are relevant here, too. Producers have the real opportunity to sow part of their own seeds harvested in previous years, in this way saving money by avoiding purchasing sealed seed. Nonetheless, this opportunity is applicable and worthwhile primarily in the case of non-hybrid cereals, because with these plants the yield loss resulting from not using sealed seeds is not significant. Even so, as from 2009 producers are obliged to pay a royalty when using self-produced seeds of originally protected varieties. In 2010 the royalty for winter wheat varied between 600 and 900 Ft per hectare depending on the breed (for winter durum wheat 1385 Ft/ha). The two farms I observed use sealed seeds of course, which is why I could use them as research subjects.

Precision farming can reduce the costs of fertilizers, pesticides and seeds. SULYOK and associates demonstrated that applied precision techniques result in cost reduction in the case of fertilizers as compared to traditional crop production methods (SULYOK et al., 2011).

3.3. Revenue, production value and gross margin of winter wheat production

Table 1 demonstrates the **gross margin** calculation of three crops. The revenue, the production value, the direct production cost and also the **gross margin** are the smallest in the case of winter wheat.

Table 1. Comparison of the important economic factors of winter wheat production with two other important crops

Denomination	Measure	Winter wheat	Winter rape	Maize
Yield	t/ha	4.2421[1]	2.247[1]	6.6[2]
Selling price	Ft/t	46 113[3]	124 581[3]	47 307[4]
Revenue	Ft/ha	195 611	279 934	312 226
Area based payment (subsidy)	Ft/ha	46 535	46 535	46 535
Gasoline subsidy	Ft/ha	7 566	7 566	7 566
Subsidies	Ft/ha	54 101	54 101	54 101
Production value	Ft/ha	249 712	334 035	366 327
Direct cost	Ft/ha	133 997	208 934	187 969
Gross margin (without subsidies)	Ft/ha	61 614	70 999	124 256
Gross margin (**with subsidies**)	Ft/ha	115 715	125 100	178 357

[1] *LUKÁCS-HORPÁCSINÉ, 2011 (national factual data)*
[2] *KOSZTOLÁNYI, 2011 (MgSzH projection, 27 July 2011)*
[3] *AKI PÁIR average prices in July, 2011*
[4] *AKI PÁIR average prices in September, 2011*
Source: Author's own calculation and editing, 2011

One should differentiate the gross margin involving subsidies from the gross margin without subsidies. Both types of gross margin show prospective and profitable conditions for all three crops in Hungary, although one must note that the weather conditions in the production year of 2011 were really favourable and long-term projections cannot be made on the basis of this year's yields.

In the case of the gross margin involving subsidies the ratio of subsidies is around 30–47%, and it is the highest in the case of winter wheat. In less favourable years the subsidies serve as loss mitigating factors and not as extra profit. Subsequently, the maintenance of the subsidies is vital for the long-term stability of the agricultural sector.

3.4. Ceteris paribus scenario analysis of wheat production

Figure 5 demonstrates the development of the gross margin of winter wheat production according to the different scenarios. I chose the values for specific yield as 2t/ha in the case of the pessimistic, 4t/ha in the case of the realistic and 6t/ha (close to record level) in the case of the optimistic scenario. In the calculation I also used three different values in the case of the selling price: 30 000 HUF/t, 40 000 HUF/t, 50 000 HUF/t accordingly.

When calculating with the pessimistic specific yield (that is with 2t/ha), it can be observed that the gross margin can be positive only when the selling price is the highest and the subsidies are taken into account. Nevertheless, in a severe drought such a rate of yield loss might occur.
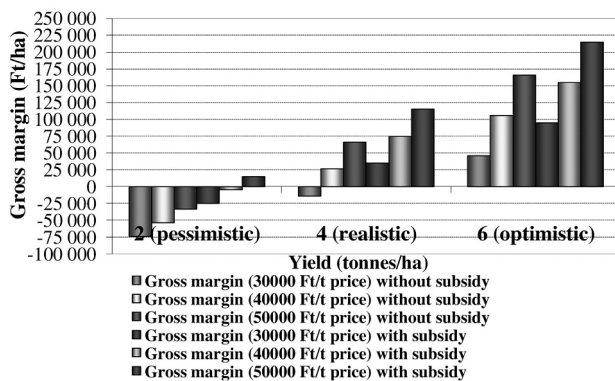
Legend:
■ Gross margin (30000 Ft/t price) without subsidy
□ Gross margin (40000 Ft/t price) without subsidy
■ Gross margin (50000 Ft/t price) without subsidy
■ Gross margin (30000 Ft/t price) with subsidy
□ Gross margin (40000 Ft/t price) with subsidy
■ Gross margin (50000 Ft/t price) with subsidy

Figure 5: Scenario analysis of the gross margin of wheat production
Source: Author's own calculation and editing, 2011

On the other hand, in the realistic scenario the sector's gross margin would be negative only when the selling price is the lowest and the subsidies are ignored, otherwise it would be positive. In the optimistic scenario the gross margin would be always positive.

However, the gross margin also includes the overhead costs, and as a consequence in the pessimistic scenario the sector's net income would undoubtedly be negative after deducting the overhead costs. It must also be noted that in the pessimistic scenario subsidies play a loss minimizing role.

4. Conclusion

The importance of winter wheat production in Hungary is beyond dispute, which is reflected also in its high representation within the system of crop rotation. However, observing its situation in 2011, its gross margin attainable per hectare is below that of both rape and maize. In the case of winter wheat the share of subsidies is 47% within its gross margin. Nevertheless, in the case of maize – which shows better profitability indicators – the share of subsidies is also 30% within its gross margin. The maintenance of subsidies is vital in the long run, because the ratio of subsidies was high in favourable production years, too. In less favourable years the subsidies serve as loss minimising possibilities. Nonetheless, the extra profit attainable this year due to the good weather conditions might create an opportunity for the farms to launch long-term investments, which is in the interest of our national economy as well.

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