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Ph.D. thesis

**THE COMPARATIVE ECONOMIC ANALYSIS OF HUNGARIAN
AND GERMAN APPLE PRODUCTION OF GOOD STANDARD**

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1. OBJECTIVES OF THE RESEARCH

Changes of the economic and market environments, setting the fields and tendencies of the sector development, as well as the present situation of our apple enterprise all equally justify and make investigating the comparativeness, profitability and efficiency of the Hungarian apple production important in a highlighted way.

Because of the extremely heterogeneous feature of the participants in the Hungarian apple enterprise, especially in case of size, state of productive stock, technical knowledge and capital strength, it is not practical to focus on enterprise averages within the farm business analysis forming the object of the research. In this way in my thesis I concentrate only on a narrower producer segment (on a more homogenous sample), on firms producing on good standard, which may form the significance of the Hungarian apple production in the future, that is they are capable of operating in an efficient, economic and competitive way by all odds. As these concepts are extremely relative, their precise determination is possible only by comparing them to something. When choosing the comparing basis it is practical to compare ourselves to a Western-European country having a developed horticulture. My choice was Germany for several reasons, which is the fourth biggest apple producing member state of the European Union.

Regarding the above mentioned, I set the general objectives of my research as follows:

1. Evaluating the efficiency as well as the short and long run economy as the basically factors determining competitiveness of the Hungarian apple production in an absolute way.
2. Evaluating the efficiency and economy of the Hungarian apple production in a relative way by the complex comparative economic analysis of the Hungarian and German apple production of good standard, determining our advantages and disadvantages with respect to these factors.

I set two basic research hypotheses in harmony with the general objectives, which are the followings:

1. The production in Hungarian apple producing firms of good standard may be carried out in an appropriate efficient and economic way.
2. Firms producing of good standard in Germany are able to reach more favourable efficiency and better economic parameters than in Hungary.

I endeavor to fulfill the following specific objectives in connection with the general objectives by analyzing both countries one by one then comparing them:

1. What characterizes the natural inputs, costs and as well as their structure?
2. What output levels and parameters (yield, quality, marketing price, production value) characterize the production?
3. What are the tendencies of the efficiency and economies of production from short-term and long-term aspects?
4. What characterizes the profitability if the different states of external environment, such as investment subsidies, yields, quality and marketing price are changing?
5. What are the parameters of the investment profitability with respect to yields, quality and marketing price?
6. How is the profitability of the Hungarian apple production in harmony with that of German apple production, in which factors do our advantages and disadvantages appear?

In order to realize the specific objectives, and answer the questions, I find completing the following tasks necessary:

1. Analyzing the standard and structure of the natural inputs and production costs for the two periods of the plantation lifetime, that is setting apart to the periods of investment and productive age.
2. Evaluating the output conditions (yield, quality, marketing price, production value) being typical to the productive period.
3. Making a detailed analysis of the results of the farming and the efficiency of production in the productive period (short-term view), as well as carrying out an investment appraisal for the whole lifecycle of the plantation (long-term view).
4. Making a sensitivity analysis for the profitability of the production to simulate the effects of the different states of the economic and natural environment.
5. Carrying out critical value examination.
6. Determining our farm business advantages and disadvantages based on the results of the examination above mentioned.

2. PRELIMINARIES AND UTILIZED METHODS

2.1. The Object of the Research, the Investigated Ventures

According to the objectives, the research focuses on just the ventures producing on good standard. This is basically the segment which is expected to most probably operate in an effective and competitive way, thus my results and conclusions refer to these ventures and plantations with respect to both countries.

The good production standard may be hardly defined, and is an extremely relative concept. The production standard is determined by several factors but first of all by the factors of output, such as yields and product quality. Thus during my work, I selected the firms being classified into this group according to professional and experimental way on one hand, and on the basis of the following rule on the other hand: a firm or a plantation is considered to produce on a good standard considering the present expectations if it is able to realize an average yield of 30 tons per hectare for a long run, from which at least 80% is of food quality.

It is also important to fix the fact that the plantation surface characterized by this concept in Hungary makes up 3 000 to 4 000 hectares of the present total 40 000 hectares according to the plantations on one hand, and to my estimation on the consumer side on the other hand, thus the results of my investigation focus only on this segment constituting approximately 10%.

2.2. Parameters of the Examined Plantations

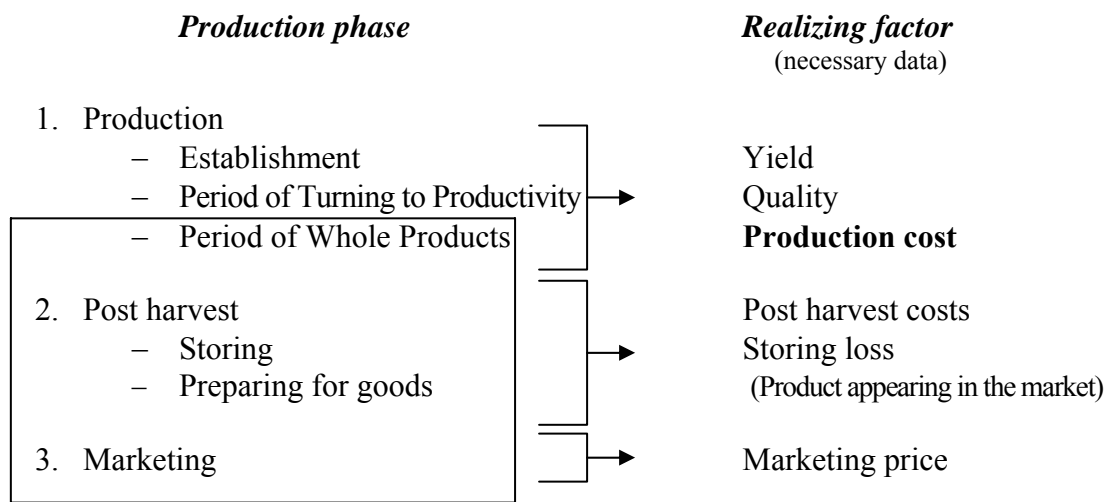
Taking the European and domestic tendencies into consideration, it is probable that the majority of the productive area, just like in Germany nowadays, will be standing on weak growing rootstock (typically M9 rootstock), will be of thick spatial position (line width of 3,0 to 4,0 meters and stock width of 0,7 to 1,5 meters), having great number of stocks per hectare (1 500 to 5 000 trees per hectare), having a spindle-like crown form and being intensive plantations. Their attachments are the construction of support and the irrigation system depending on weather and climate conditions. This is strengthened

by the fact that primarily such plantations were established in Hungary during the past decade.

In this way, both in Hungary and Germany plantations having the above mentioned parameters got into the data collection. Fixing the above mentioned parameters is important from the farm business aspect, as we cannot speak about the economics, the costs and profitability of apple production in general. The costs, yields and quality in different types of plantations and in enterprises producing on different standard may be totally diverse.

2.3. Data Requirement of the Research

Firstly, the data requirement being necessary for realizing the objectives of the research determines the method formation. I was attentive to constructing the fruit production activity for determining the necessary data (*Figure 1.*), regarding that the unit of the analysis is not the venture but a unit technology of 1 hectare, thus I determined the revenues and costs relating to the apple production of a venture to 1 hectare plantation surface.



Source: own figure

Figure 1. **The Three Phases of Fruit Production**

On the basis of *Figure 1.*, in order to evaluate the farm business conditions of fruit production, the collection of the following data is necessary:

- natural inputs and input prices for calculating the realized yields and product quality as well as the production costs in the production phase,

- costs of storing and preparing to goods in the post harvest phase, storing loss, and the characteristics of the products (goods) appearing in the market at the end of this process,
- marketing price realized in the sale phase.

By the data above mentioned a complex farm business analysis may be carried out involving every phase of fruit production.

2.4. The Method of Data Collection

Considering the fact that the major ratio of the ventures do not have reliable and precise data on the costs of production due to the lack of appropriate registration, the analysis of the cost side could not be based on collecting cost data, though its determination is the most complex task, and it forms the significant part of the information need of the research (*Figure 1.*). Collecting natural inputs and constructing the whole production technology seemed to be the proper method, then which could be developed into production costs by input prices collected from other sources (not from producing enterprises). Data collection was carried out by the help of data collecting sheets for production created especially for this purpose. Collecting data relating to yields, quality, post harvest costs and storing losses as well as marketing prices is not so complex at all.

Collecting data relating to yields, quality and natural inputs of the production took place exclusively at the producing enterprises, while information on input prices, post harvest costs, storing losses and marketing price may be collected from other sources, and could be improved (e.g. commercial firms turning over plant-protecting agents and fertilizers, firms providing rental services, producer organizations, research institutes, other commercial enterprises). I created the database by mainly primary data collection and to a smaller extent as a supplementary purpose secondary data collection.

I completed my supplementary data collecting work concerning producing enterprises in the Lake Boden Region in Germany, and in the Northern Great Plain Region in Hungary. I reflected the production technology of 7-7 ventures in both countries carried out in plantations having detailed parameters. Data collection occurred from June to August in 2005 in Germany, while in Hungary it happened from November 2005 to

April 2006 and involved the collection of production technologies for the years 2004 and 2005. The intensive apple plantation surfaces in the examined enterprises were 158 hectares in Germany and 313 hectares in Hungary.

There was a previous survey going before this data collection in Hungary in the year 2004 aiming at collecting data for the production technology for the year 2003, which involved 30 plantations of 19 enterprises. There were several types of cultivation systems in these plantations. Though the resulted data do not attach strongly to my investigation, their aim, however, was outstandingly important, for the followings:

- working out, testing and developing the method for data collection,
- investigating horticultural, professional and economic correlations necessary for constructing the farm business model in a broader way,
- revealing the farm business characteristics as well as cost and profit relations of different plantation types.

It is clear that the research work was overtaken by a preparing, testing and developing work based on a greater sample and a broader basic.

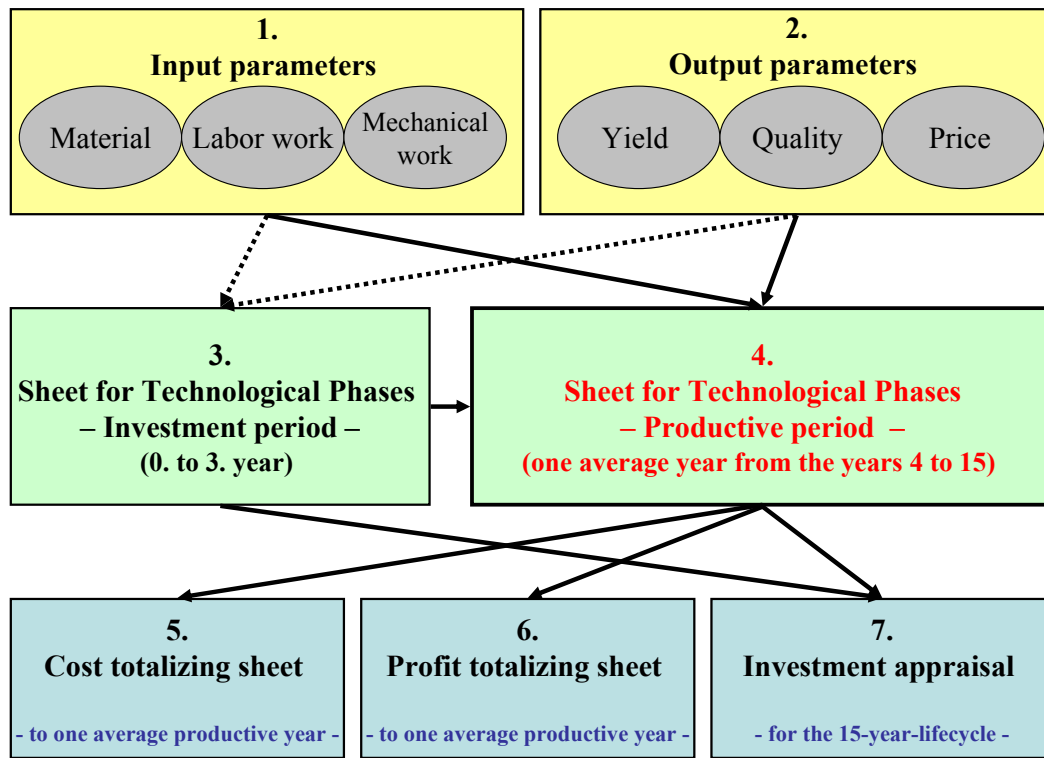
2.5. Evaluating the Data, Constructing and Operating the Model

The basis of my analyzing and evaluating work of my dissertation is the model constructed by the help of own data collection carried out at producing enterprises and relating to just natural inputs and results of the production.

The model reflects the farm business conditions of the production in a production technology of 1 hectare. This basically means that I neglected the internal enterprise environment (production structure, management, etc.) because of its extremely heterogeneous type and in this way due to its difficult handling and I determined it to 1 hectare. Thus it is not the enterprise which is important but its apple production raising from the venture and clearing it from the internal environment.

The significance of the operation of the model involving seven modules is that the technology constructed by the natural inputs in the 3. and 4. modules determines the

cost and profit conditions as well as the profitability of the plantation investment according to the installed input and output parameters (1. and 2. modules). (Figure 2.)



Source: own figure

Figure 2 **Structure of the Farm Business Model**

The model is able to evaluate the cost and profit conditions of plantation enterprises in a complex way in case of any technology, and to consider the effects of any changes in input prices (material, machine), wages, yields, quality and marketing prices as well as the effects of subsidies for machine investments, post harvest investments, plantation investments to the cost of farming and to profitability in the short and long run.

I built up mean models both for Hungary and Germany on the basis of the gained experience after evaluating the data of the certain enterprises one by one. These models form the basis for the analyzing and comparing work and reflect the averages of the 7-7 enterprises producing on good standard. The mean models were constructed for a normal year exempt from greater positive or negative weather extremes and plant protecting extremities but naturally they are able to simulate these different states of the reality.

3. MAJOR FINDINGS OF THE THESIS

I summarize the major findings of my research in harmony with the specific objectives as follows:

1. *What characterizes the natural inputs, costs and as well as their structure?*

Examining the investment costs, I conclude that there are significant differences between the Hungarian and German apple production. The investment cost in Germany is much higher, the difference is 6 100 thousand HUF per hectare, that is it is 2,5 times higher. This difference consists of plantation cost of 4 800 thousand HUF, and treatment cost of 1 300 HUF. Regarding plantation costs, the difference of 4 800 thousand HUF between the two countries substitute 35% planting material, while 60% equals with the costs of the ice safety system and irrigation system as supplementary establishments. Thus, all in all this huge difference may be accounted for the necessity of ice safety system (*Table 1.*).

Table 1. Comparing the Investment Costs

Denomination	Hungary		Germany	
	Cost (HUF/ha)	Ratio (%)	Cost (HUF/ha)	Ratio (%)
Area and soil preparation	341 400	8,5	233 620	2,3
Establishing construction of support	802 000	19,9	1 030 240	10,1
Planting and graft	1 179 600	29,3	2 882 556	28,4
Irrigation system	550 000	13,7	0	0,0
Ice safety system	0	0,0	3 420 900	33,7
Other	228 000	5,6	300 000	3,0
Plantation cost	3 101 000	77,0	7 867 316	77,5
1. year treatment	201 250	5,0	405 360	4,0
2. year treatment	220 550	5,5	736 624	7,3
3. year treatment	504 200	12,5	1 144 996	11,2
Investment cost	4 027 000	100,0	10 154 296	100,0

Source: own calculation

Direct cost in Hungary is 1 700 thousand HUF per hectare, while in Germany it is 2 700 thousand HUF per hectare during the years of operation (productive period). In the Hungarian apple production, near two third of the direct production costs incur during production, a little more than one third of this costs incur during the post harvest period (*Table 2.*).

The costs of plant protection (26%), harvest (15%) and fertilizing (13%) are significant among the costs during the production period. The depreciation cost of the plantation takes up of 20%, which is the second most significant cost. The most significant costs (*Table 3.*) are material costs (33%) and personal costs (23%).

Table 2. Cost Structure of Working Phases in Productive Period

Phases	Hungary		Germany	
	Cost (HUF/ha)	Ratio (%)	Cost (HUF/ha)	Ratio (%)
Total cost of production	1 042 888	100,0	1 991 804	100,0
Winter pruning	43 825	4,2	124 770	6,3
Using manure	32 732	3,1	40 080	2,0
Fertilizing	85 572	8,2	57 117	2,9
Liming	18 000	1,7	0	0,0
Soil cultivation	16 000	1,5	26 400	1,3
Weed control	27 895	2,7	100 419	5,0
Plant protection spraying	271 122	26,0	284 346	14,3
Rodent and grub control	4 495	0,4	0	0,0
Yield and growth regulation	36 800	3,5	105 106	5,3
Green pruning, phytotechnics	19 000	1,8	32 048	1,6
Irrigation	25 175	2,4	0	0,0
Harvesting	159 373	15,4	566 290	28,4
Other work	8 075	0,8	48 989	2,5
Other direct cost	89 300	8,6	84 240	4,2
Depreciation of the plantation	205 524	19,7	521 999	26,2
Total post harvest cost	636 980	100,0	740 316	100,0
Storing	530 096	83,2	740 316	100,0
Preparing for goods	106 884	16,8	0	0,0
DIRECT PRODUCTION COST	1 679 868		2 732 120	

Source: own calculation

In Germany, three quarter of the direct cost incur during the production period, more than one quarter in the post harvest period. Harvesting cost is outstanding from the costs of production (*Table 2.*), which consists of 28% from the total costs of production. This is followed by the depreciation cost (26%) and plant protection cost (20%). The personal costs are significant ones because of the high wages, which takes up of 39% of the production phase. It is followed by the depreciation cost due to the extremely high investment costs, which is one quarter of the costs of production.

It can be concluded that there is a significant difference between the two countries in the direct production costs per hectare in the productive period. The difference is 1 000 to 1 100 thousand HUF. 90% of the cost difference occurs in the production phase, while only 10% incur during the post harvest period. The cost difference of production phase can be explained in 85 to 90% by the followings: winter pruning, weed control, yield regulation, harvesting and depreciation cost. Moreover, only two costs, harvesting and depreciation costs are responsible in 75% for the difference. It should be highlighted that these phases except weed control are just the most labor-intensive phases, and the costs difference is thanked not to the technological differences in money but the 400-500% higher wages in Germany. In case of use of manure and fertilizers, soil cultivation, plant protection and other direct costs, differences to a larger extent cannot be experienced.

Table 3. Cost Structure of Cost Types in the Productive Period

Phase	Hungary		Germany	
	Cost (HUF/ha)	Ratio (%)	Cost (HUF/ha)	Ratio (%)
Total costs of production	1 042 888	58,6	1 991 804	68,5
Material cost	349 381	19,6	409 233	14,1
Personal cost	237 279	13,3	776 550	26,6
Mechanical cost	161 404	9,1	199 782	6,9
Depreciation of plantation	205 524	11,6	521 999	18,0
Other direct cost	89 300	5,0	84 240	2,9
Total post harvest cost	636 980	35,8	740 316	25,5
Material cost	79 762	4,5	121 311	4,2
Personal cost	60 038	3,4	0	0,0
Mechanical and building cost	394 405	22,2	551 805	19,0
Bundle depreciation	63 000	3,5	67 200	2,3
Other direct cost	39 775	2,2	0	0,0
DIRECT PRODUCTION COST	1 679 868	94,4	2 732 120	94,0
Overhead cost	100 000	5,6	174 000	6,0
TOTAL PRODUCTION COST	1 779 868	100,0	2 906 120	100,0

Source: own calculation

There is not any significant difference between material and mechanical costs; the differences are accounted for “tiny tots” (*Table 3.*) This two cost types are responsible in only 10% for the difference of 949 thousand HUF in the costs of production phase.

The other direct costs are the same, in this way the reasons of the higher German costs are the personal costs and depreciation cost. Personal cost is higher by 540 thousand HUF (by 227%), the depreciation cost is higher by 316 thousand HUF (by 153%) in Germany, and thus the extra costs appear here. There is a significant difference in the post harvest phase only in building costs, of which 97% is depreciation.

Summarizing the above mentioned, I can conclude that there are two reasons (70 to 80%) for the difference of 1 000 to 1 100 thousand HUF between the direct costs per hectare of the two countries: the first is the higher wages in Germany, and the second is the higher establishing costs, which is primarily thanked to the necessity of establishing the ice safety system.

2. *What output levels and parameters (yield, quality, marketing price, production value) characterize the production?*

The Hungarian firms realize an average yield of 37 tons per hectare, 86% food quality ratio (76% is I. class, 10% is II. class), and the average price is 76,1 HUF per kilogram for the apple of I. class. Regarding these factors, revenue of 2 300 thousand HUF may be reached in the Hungarian apple production. Supplementing this by subsidies, a production value of 2 429 thousand HUF may be realized, which is an average value for ventures producing good quality products (*Table 4.*).

In Germany the average yield is 41 tons per hectare, of which an extremely high ratio, 91% is food quality, and within this 85% is I. class, and 6% is II. class. The average price for the producer is 102,5 HUF per kilogram for the apple of I. class. In the German apple production the revenue is 3 666 thousand HUF, which is considered to be an average in a normal case. The revenue supplemented by subsidies results in the production value of 3 748 thousand HUF (*Table 4.*)

To sum up, I conclude that German firms are able to produce higher yields by 4 tons per hectare, but the yield difference relating to the I. class products is near 7 tons per hectare. Considering these yield and price parameters, German firms can reach higher revenue by 1 300 to 1 400 thousand HUF or by 55 to 60% per hectare.

Table 4. The Production Value and its Parameters in the Productive Period

Denomination	Unit	Hungary	Germany
TOTAL YIELD	t/ha	37,00	41,00
from which: - apple for food, I. class	t/ha	28,12	34,85
- apple for food, II. class.	t/ha	3,70	2,46
- apple for industry purpose	t/ha	5,18	3,69
Storing loss	t/ha	1,78	1,49
MARKETED YIELD	t/ha	35,22	39,51
from which: - apple for food, I. class	t/ha	26,55	33,46
- apple for food, II. class.	t/ha	3,49	2,36
- apple for industry purpose	t/ha	5,18	3,69
Marketing price:	HUF/kg	76,10	102,50
- apple for food, I. class	HUF/kg	53,30	61,50
- apple for food, II. class.	HUF/kg	20,00	25,00
- apple for industry purpose	HUF/kg	20,00	25,00
REVENUE	HUF/ha	2 309 862,05	3 666 728,40
from which: - apple for food, I. class	HUF/ha	2 020 095,81	3 429 240,00
- apple for food, II. class.	HUF/ha	186 166,24	145 238,40
- apple for industry purpose	HUF/ha	103 600,00	92 250,00
SAPS	HUF/ha	20 000,00	0,00
Agrar-environmental subsidy	HUF/ha	100 000,00	82 000,00
PRODUCTION VALUE	HUF/ha	2 429 862,05	3 748 728,40

Source: own calculation

3. *What are the tendencies of the efficiency and economies of production from short-term and long-term aspects?*

In Hungarian apple production, under a normal condition, a contribution of 750 thousand HUF may be expected from firms producing good quality products. After regarding the overhead cost a net profit of 650 thousand HUF may be reached. Under average and normal conditions, German firms can reach 1 016 thousand HUF contribution per hectare, which is a net profit of 843 thousand HUF per hectare when considering overhead costs.

Investigating the profitability of apple in a short run, it can be summarized that German firms realizing 55 to 60% higher production value and 60 to 65% higher production cost are able to produce 35 to 40% higher contribution, which means 250 to 300 thousand HUF per hectare surplus contribution (Table 5.).

Table 5. Results of Farming in the Productive Period

Denomination	Unit	Hungary	Germany
PRODUCTION VALUE	HUF/ha	2 429 862	3 748 728
Direct production cost	HUF/ha	1 679 868	2 732 120
CONTRIBUTION	HUF/ha	749 994	1 016 608
Overhead cost	HUF/ha	100 000	174 000
Total production cost	HUF/ha	1 779 868	2 906 120
NET PROFIT	HUF/ha	649 994	842 608
Total depreciation cost	HUF/ha	705 490	1 197 923
Operation cost (expense)	HUF/ha	1 074 377	1 708 197
CASH FLOW	HUF/ha	1 355 484	2 040 531

Source: own calculation

Examining the efficiency of the production, relating to labor need and labor productivity, the situation is more favourable in German apple production. German firms use 50 to 60% less labor for producing a single revenue or contribution (Table 6).

Table 6. Major Indicators Reflecting the Efficiency of Production

Denomination	Unit	Hungary	Germany
Labor Need			
Labor need per one hectare	Working hours / ha	625,9	387,7
Labor need for producing 1 ton product	Working hours / t	16,9	9,5
Labor need for realizing 100 thousand HUF revenue	Working hours / 100 thousand HUF	27,1	10,6
Labor need for realizing 100 thousand HUF contribution	Working hours / 100 thousand HUF	83,5	38,1
Cost Need			
Prime cost	HUF / kg	50,5	73,6
Cost to production value ratio	%	73,2	77,5
Profitability			
Profit to cost ratio	%	36,5	29,0
Profit level	%	26,8	22,5
Contribution per 1 kilogram product	HUF / kg	20,3	24,8
Cash flow per 1 kilogram product	HUF / kg	36,6	49,8

Source: own calculation

With respect to cost need, prime cost and cost to production value ratio are more encouraging in Hungary. We have a great advantage especially in case of prime cost, as it is 23 HUF per kilogram lower than it is in Germany. Regarding the profitability of production, the profit is 20 to 40% higher in the German apple production, while the

profit to cost ratio is more favourable in Hungary by 20 to 25% (relative percentage) (Table 6.)

Investigating the profit in a long run, that is reflecting the economies of the plantation investment for the whole lifecycle, it can be stated that the production in Hungary may be carried out in a profitable way concerning the above mentioned yields, quality and price and considering 7% calculative interest rate. At the end of the lifetime of the investment, that is in the 15th year, NPV of 2 492 thousand HUF is reached. The returning happens in the 9th year, the IRR is 15,3% (Table 7.).

Table 7. Investment Efficiency Indicators of Apple Production in the Two Countries

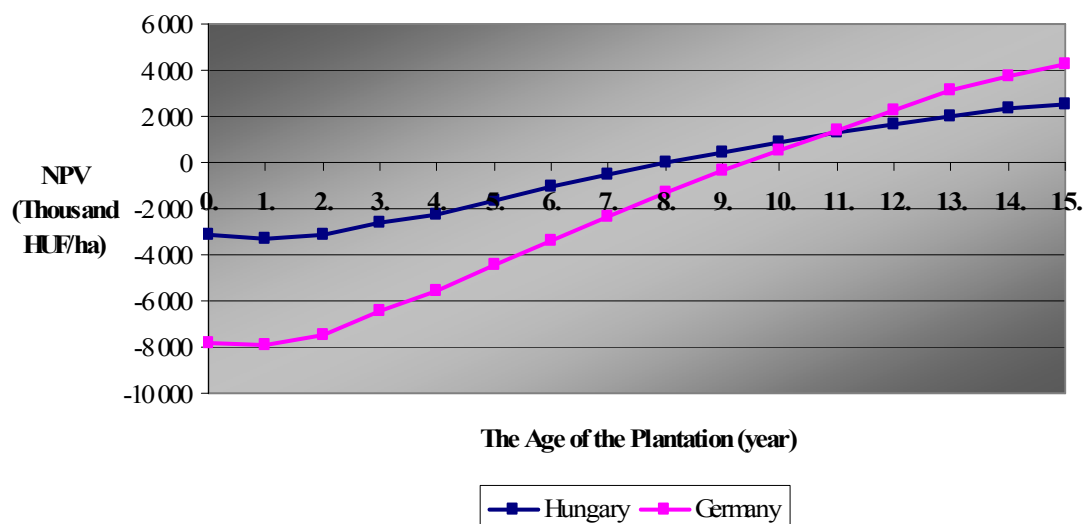
Denomination	Unit	Hungary	Germany
NPV (Net Present Value)*	Thousand HUF/ha	2 492	4 239
DPP (Discounted Payback Period)	year	9	10
PI (Profitability Index)	-	1,80	1,54
IRR (Internal Rate of Return)	%	15,3	9,9

Source: own calculation

* Hungary: $r = 7\%$; Germany: $r = 4\%$

The German apple production can be carried out also in an effective way realizing the above mentioned yields, quality and prices, as well as considering 4% calculative interest rate. At the end of the lifetime, NPV of 4 239 thousand HUF is reached, the payback period is 10 years (Figure 3.), the IRR is 9,9%.

When comparing the economic aspects of the investment, it is clear that the efficiency (NPV) in absolute value is more favourable in Germany than in Hungary, while the IRR reflecting the average, annual profit to asset ratio is more approving in Hungary. There is not a great difference between the payback periods of the investment; in Hungary the returning happens in the 9th year, while in Germany in the 10th year (Table 7.).



Source: own calculation

Figure 3. The NPV* in the Hungarian and German Apple Production

* Hungary: $r = 7\%$; Germany: $r = 4\%$

4. *What characterizes the profitability if the different states of external environment, such as investment subsidies, yields, quality and marketing price are changing?*

Examining the economic aspects of Hungarian and German apple production determined to the whole lifecycle, without investment subsidies and considering the same calculative interest rate for both countries, I can conclude that (Table 8. and 9.) the profit (NPV) in absolute amount is more favourable in Hungary in case of a realistic case, while it is more approving in Germany in an optimistic view, while under a pessimistic condition the economic aspects are unfavourable in both countries, the returning does not occur even during the whole lifecycle of the plantation.

Table 8. Investment Efficiency in Hungarian Apple Production without Investment Subsidies

Denomination	Unit	Optimistic scenario	Realistic scenario	Pessimistic scenario
NPV ($r = 7\%$)	Thousand HUF/ha	5 960	2 492	- 443
DPP	year	6	9	> 15
PI	-	2,92	1,80	0,86
IRR	%	23,6	15,3	5,1

Source: own calculation

Moreover, the payback period (DPP) and indicators reflecting profit to asset ratio (IRR, PI) are better in every case under Hungarian conditions, which is thanked to the much lower establishing costs.

Table 9. Investment Efficiency in German Apple Production without Investment Subsidies

Denomination	Unit	Optimistic scenario	Realistic scenario	Pessimistic scenario
NPV(r = 7%)	Thousand HUF/ha	7 620	1 764	- 3 224
DPP	year	8	12	> 15
PI	-	1,97	1,22	0,59
IRR	%	17,5	9,9	0,3

Source: own calculation

Considering investment subsidies, the result in absolute amount is more encouraging in Germany in case of optimistic scenario; in case of realistic and pessimistic scenarios it is more favourable in Hungary, while profit to asset ratio is more approving in Hungary in every case (*Table 10. and 11.*)

Table 10. Investment Efficiency in Hungarian Apple Production Regarding Investment Subsidies

Denomination	Unit	Optimistic scenario	Realistic scenario	Pessimistic scenario
NPV (r = 7%)	Thousand HUF/ha	8 661	5 187	2 246
DPP	year	4	5	7
PI	-	6,10	4,05	2,32
IRR	%	40,6	31,0	20,2

Source: own calculation

Investment subsidies improve the reachable NPV by 2 700 to 2 800 thousand HUF in both countries, and in Hungary they make the production profitable even under pessimistic conditions, while in Germany it is not true even in this case.

Table 11. Investment Efficiency in German Apple Production Regarding Investment Subsidies

Denomination	Unit	Optimistic scenario	Realistic scenario	Pessimistic scenario
NPV (r = 7%)	Thousand HUF/ha	10 438	4 582	- 406
DPP	year	6	8	> 15
PI	-	2,96	1,86	0,92
IRR	%	25,2	16,4	5,9

Source: own calculation

All in all, the conclusion can be made that the investment subsidies make the farming of Hungarian apple producing firms more calculable from the economic aspect, without them the profitability may be extremely bad in case of a more unfavourable situation.

5. *What are the parameters of the investment profitability with respect to yields, quality and marketing price?*

The profitability of plantation investment in Hungary without investment subsidies requires at least 30,3 tons per hectare multiyear average yield concerning 76,1 HUF per kilogram average price and 86% food quality ratio, while taking the investment subsidy into consideration, 22,9 tons per hectare may be sufficient for returning. These values in German firms are much higher; because of the high investment and operational costs only 37,7 and 32,4 tons per hectare yield may ensure the profitable production in a minimum way concerning 102,5 HUF per kilogram average price and 91% food ratio. This means 8 to 10 tons per hectare higher yield than in Hungary (*Table 12.*)

Hungarian firms have to reach an average price of at least 62,4 HUF per kilogram in a long run in a realistic situation, while in case of subsidies even an average price of 48 HUF per kilogram covers the minimal profitability condition concerning 37 tons per hectare. It is clear that this value is higher in Germany, where an average price of 84,0 to 95,3 HUF per kilogram should be realized.

Table 12. Critical Parameters of Plantation Investment Profitability in the Apple Production of the Two Countries, Ceteris Paribus

Factor	Unit	Hungary		Germany	
		Without Investment Subsidy	With Investment Subsidy	Without Investment Subsidy	With Investment Subsidy
Yield	t/ha	30,3	22,9	37,7	32,4
Ratio of I. class apple *	%	55,0	32,0	77,0	62,0
Marketing price of I. class apple	HUF/kg	62,4	48,0	95,3	84,0

Source: own calculation

* ratio of II. class apple in Hungary is 10%, in Germany it is 6%.

I can conclude that German firms have to reach 25% higher yield per hectare and 50% higher marketing price regardless investment subsidies, while with investment subsidies

40% higher average yield and 70 to 80% higher average price than Hungarian firms in order to fulfill the minimal level of profitability.

6. How is the profitability of the Hungarian Apple Production in harmony with that of German apple production, in which factors do our advantages and disadvantages appear?

The profitability of the Hungarian apple production considering firms producing on high standard is not lagged behind significantly from that of German firms, moreover in certain cases it reflects a more positive situation. It is unfavourable, however, that this statement is true only for 8 to 10% of our whole apple plantation surface.

The results of the investigations highlighted the fact that in comparison with Germany our farm business advantages manifest in three factors: in 70 to 80% lower wages, in 15 to 30 % higher investment and subsidy intensity and in the fact that at present we cannot neglect the ice safety system which is rather expensive. By the increasing wages, the narrowing subsidy opportunities and incidentally the appearing harmful weather phenomenon, these advantages may be continuously ceased. Our definite disadvantage appears in the level of marketing price, considering the fact that producers in Hungary realize 30 to 35% lower marketing price, which is in connection with the probably much lower level of organization among farmers, in the market and in the logistical background.

4. NEW AND NOVEL SCIENTIFIC FINDINGS

1. I worked out a **data collecting method** based on natural inputs by which a more detailed database may be developed being able to analyze economic decision makings in any fruit enterprise in a better way than present data collecting methods used widely and based on counting registrations.
2. I constructed a “**Farm business model**” for analyzing the apple production from a complex, farm business aspect, which is capable of analyzing the investment and productive periods in an economic way, of analyzing the whole investment covering all the plantation lifecycle, as well as of carrying out a sensitivity analysis for simulating optional conditions of the natural and economic environment. At the same time the model provides the analyzing structure by which I suggest the completion of a complex farm business evaluation of plantation fruit enterprises.
3. As a complex system of the data collecting method and the farm business model I developed an **analyzing tool** which is suitable for farm business evaluation of plantation fruit enterprises in any producing venture, in this way for strengthening decisions both in producing ventures and at the level of enterprise regulation.
4. I made farm business analysis especially relating to a narrow producing segment, to ventures producing on good standard, and I concluded that production in the Hungarian apple producing ventures of good standard may be completed by a proper efficiency and in an economic way.
5. I made the consideration of efficiency and profitability of the Hungarian apple production relative by comparing it to a Western European country (Germany) having a developed horticulture. In spite of my second hypothesis, I concluded that the profitability of the Hungarian apple production is not significantly lagged behind that of German ventures; moreover under certain conditions better efficiency and profitability may be reached in Hungary.

5. THE PRACTICAL USE OF THE RESULTS

The major result of the dissertation *in the field of research* is the established data collecting method and the farm economic model for widespread data evaluation. The results are essential in a way that we have had rather little information for the analyzed producing segment of a good standard in Hungary.

My results show guidelines for setting enterprise developing tendencies *for decision makers in technical policy*, regarding the fact that I evaluated the profitability of the domestic apple production in a more precise way by an international comparison focusing on a segment being expected to most probably carry out a competitive production in the future and being not analyzed in a detailed way yet. Besides the factual results, it is worth mentioning here that by the complex system of established data collecting method and farm economic model, the analysis may be carried out to any type of plantations, cultivation system, determining the profitability, efficiency and competitiveness of our plantations and ventures by this.

The results of the dissertation may be utilized well in *education*. The analysis due to its structural content may be well fit into the subject called “Enterprise Economics” based on the traditions of the Debrecen Farm Business Academy. Besides, the calculation may be used as examples when educating methods of investment appraisal and cost analysis. The created tables and figures help the illustration in a better way.

One of the valuable results of the research *for producing ventures* is the creation of a complex data collecting and evaluating system, which is able to evaluate quickly the farm business conditions of any plantation fruit enterprise in any producing venture, even if there is not any own counting or farm business database available. Besides these, my findings highlight that in what area our advantages and disadvantages appear, thus it helps in revealing the reserves for increasing profit. Moreover, the results of the investment appraisal calculation, regarding the effects of the investment subsidies, and different yield, quality and price conditions, as well as the critical parameters of profitability, may help the producer in preparing and making decisions for plantation establishment in an efficient way.

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