Theses of doctoral (PhD) dissertation

ECONOMIC ISSUES OF THE COMPETITIVENESS RESERVES OF HUNGARIAN GOOSE MEAT PRODUCTION

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1. RESEARCH BACKGROUND AND OBJECTIVES, PRESENTATION OF THE RESEARCH HYPOTHESES

In poultry meat production, the waterfowl sector represents a smaller share in the global and national economy compared to other poultry species. However, it plays an important role within the domestic poultry sector and is a significant source of foreign exchange income, as it is of national economic importance. The Hungarian goose sector is export oriented, producing high value-added, internationally sought-after products, but there is a seasonal increase in goose meat and goose products, it is consumed by a narrow range of people and can be considered a premium product to be sold in small volumes.

The demand for goose products depends to a large extent on consumer habits, and since prices are determined by supply and demand, the income from the activity partly depends in part on the price at which producers can sell their products. Thus, the production of goods must focus on competitiveness and products that can be sold on the market. However, it is important to note that over the past decade and a half, there has been a significant decline in Hungarian goose meat production, while Poland, one of the most important goose producers in Europe, has developed its poultry industry to such an extent that it is a constant competitor for Hungarian players of the sector.

No sectoral or operational competitiveness studies are available for the Hungarian goose sector, including meat goose production. Similarly, a farm economy analysis of meat goose fattening has not yet been carried out. Consequently, my choice of topic was justified by these reasons.

Main research objectives

In connection with the above points, the main objective of this research is to explore the factors determining the competitiveness of the domestic goose sector at the farm level, and to determine any existing reserves. Despite the fact that the sector has various purposes of production, such as fattened and lean goods, as well as feather and liver production, the research focuses on the production of lean goods (9- and 14-week-old geese).

In relation to this objective, I seek to provide scientifically sound answers to the following questions:

- How can the situation in the sector currently be described? What difficulties do the players in the sector face and what opportunities do they have?
- How to describe the natural inputs of goose meat production, the production costs and their structure under different production and technological standards and with different fattening periods? In this context, what is the level of output and what are the production indicators (output, feed conversion ratio, mortality, average daily weight gain, etc.)? And as a result, how do the results of farming and the efficiency of production develop?
- How do changes in production and economic factors affect the economic performance of production, and what are the critical parameters of profitable production in terms of inputs, yields, and input and output prices?
- What operational-level reserves affecting competitiveness characterize the sector, and under what conditions can they be used?

In accordance with the literature review, as well as the objective and the related questions, I phrased the following hypotheses:

H1$_a$ – The rearing time during goose meat production influences the production indicators characteristic of the activity, i.e. natural efficiency.

H1$_b$ – The rearing time used during goose meat production influences the results of farming.

H2$_a$ – The production indicators characteristic of goose meat production (*feed conversion ratio, average daily weight gain, mortality*) have an effect on the average cost.

H2$_b$ – The production indicators characteristic of goose meat production (*feed conversion ratio, average daily weight gain, mortality*) have an effect on the income of the activity.

In order to answer the questions formulated in connection with the objective and to test the hypotheses, I consider it necessary to perform the following tasks:

- *Situation analysis and problem identification*: identification of the weaknesses and difficulties of the sector and the exploration of the causal relations and connections between them, in order to be able to utilize farm analyses at the sectoral level as well.
- *Farm data collection and processing:* collection and processing of technology and activity-specific data on different purposes of production, genotype, as well as technological and production standards.
- *Operational modeling and complex economic analysis*: development, compilation, validation and application of a simulation model based on natural data according to the appropriate conditions for both rearing periods (9- and 14-week-old geese) and economic evaluation of the modeling results (output data of model calculations), supplemented by sensitivity tests.
- Exploration of reserves and formulation of proposals for their utilization.

2. DATABASE AND DESCRIPTION OF THE METHODS USED

To achieve the above stated objectives, I performed both primary and secondary data collection. During the secondary data collection, I collected and processed the literature data and database entries related to the field of research. With the secondary data collection, my goal was to outline the situation of the sector (both at the global, European and Hungarian economic level), the operation and trends of the market, based on international (FAO, COMTRADE) and Hungarian (NAIK AKI, KSH) databases, covering issues related to production, consumption and trade, as well as production bases specific to the sector (genetics, technology, farm size).

The preparation of the literature review was significantly affected by the fact that only a small number of sources are available for the goose sector, most of which deal with issues related to animal husbandry and genetics, and not with the economic aspects of production. It is also important to note that the mentioned databases do not differentiate between the different purposes of production in the case of geese, i.e. I used the data of the Hungarian Poultry Product Board (HPPB) and the Hungarian Goose Association and their annual reports to examine the context and role of meat production in the Hungarian national economy. However, these databases contain the data of the HPPB as well as the sectoral players that are members of the association, i.e. the range of data providers within the sector is not complete. However, the coverage is 85-90%, therefore, these data can still be considered relevant, as the largest integrations and the producers they integrate are mostly members of the organization. As a result of the mentioned differences (differences in data collection, purpose of production, coverage), the data of different databases differ significantly from each other.

Expert interviews were also used to learn about the situation in the sector and to explore the connections, some of which were conducted in 2014 and December 2015, while others were conducted in 2018 and 2019. During these consultations,

the views of representatives of key companies in the sector and the leaders of the inter-branch organization on the situation, problems and future prospects of the goose sector were collected and processed.

Based on the processed literature and expert interviews, I collected and systematized the problems of the sector and compiled its problem tree, which allows summarizing the contents of the literature review and illustrating them in a structured way. As a first step, I identified the central problem of the sector, and then the sub-problems leading to its occurrence were identified, which I systematized into a tree structure, taking into account the causal relationships between each other. With the help of the problem tree created in this way, the problems can be arranged in a logical order, as well as the causes and effects behind them (SZŐLLŐSI – NÁBRÁDI, 2008[1]; SZŰCS, 2015[2]).

During the operational data collection required to achieve the objectives, I collected technological and economic data on 9- and 14-week-old goose production from 7 pre- and post-rearing farms of a significant integration in the Hungarian waterfowl sector for the period between 2014-2018. I formed the natural efficiency indicators (number of rearing days, mortality, average daily weight gain, feed conversion ratio, average weight at the time of sale) derived from the collected production parameters, which make it possible to measure the performance of each farm and compare it to the Hungarian and international results of the sector.

Since the available domestic databases do not differentiate between different purposes of production, in order to achieve the objectives of my research, I examined the cost-income relationship of the activity in the case of different

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[1] Nábrádi A. – Szőllősi L. (2008): A baromfiágazat versenyképességének helyreállítása. Gazdálkodás. 52 (5) pp. 418-431.

[2] Szűcs I. (2015): Az üzleti tervezés módszertana és folyamata. In: Az üzleti tervezés alapjai (Szerk. Szőllősi L. – Szűcs I.). Debreceni Egyetem.19. p.

fattening periods, based on the collected economic data. I also determined both the derived indicators and the cost of the activity per rotation, as well as averaged over each farm and the different fattening periods (9- and 14-week-old geese). I used descriptive statistical methods for the processing of primary data (technological parameters, basic economic data) and the derived indicators, as well as the prime cost. During the analysis, the extreme values (minimum, maximum), the calculated mean (arithmetic mean) and the standard deviation were determined.

After analyzing the production indicators and the average cost with descriptive statistical methods, I examined the possible significant difference between the factors using an independent two-sample t-test. The condition for performing the two-sample t-test is that there is no significant difference between the values of the two groups, which I examined with an F-test. If the F-test is to be discarded because the variance of the studied population is significantly different, the independent sample t-test cannot be used to verify whether the expected values of the two samples are the same. If a significant difference can be detected, a Welch test is recommended. In addition, an additional condition for performing the test is that the two samples are independent of each other and that the population is normally distributed (HUZSVAI – VINCZE, 2012[3]). In accordance with the common practice of this field of science, the significance level was determined to be 0.05.

In the case of different rearing periods, I examined the linear relationships between production indicators and average cost using correlation and regression analysis. In the course of correlation, the effect observed between the factors and the strength of correlation are examined. Based on SVÁB (1967)[4], I used the

[3] Huzsvai L. – Vincze Sz. (2012): SPSS-könyv. Seneca Books Kiadó. pp. 40-41.
[4] Sváb J. (1967): Biometriai módszerek a mezőgazdasági kutatásban. Mezőgazdasági Kiadó. Budapest.

following guiding values to assess the strength of the significant linear correlations based on Pearson's correlation coefficient: 0.0-0.4 (loose), 0.4-0.7 (medium), 0.7-0.9 (strong) and values above 0.9 represent a very strong correlation (cit. in: MÉSZÁROS, 1981)[5].

In order to examine the change in results that can be achieved with the extra expense experienced in the case of different fattening times, I calculated additional efficiency based on the average of the examined period and the results of each year. Additional efficiency means *"the amount of additional return (Δy) per unit of additional input (Δx), i.e. Δy / Δx"* (PUPOS, 2011)[6].

As I did not have detailed economic data related to the activity, technology, genetic background and production standards, I examined the cost and income relations of the activity and the effects of the determining factors on economic indicators through model calculations. For this purpose, I compiled a simulation model calculation based on the deterministic principle. I used different input parameters (technological, economic) to build the model calculations. Technological data - which include the natural efficiency indicators of production - were determined from the on-farm data of the pre- and post-rearing farms of the waterfowl integration. The economic parameters include the input and output prices of production, as well as the specific cost items, some of which come from Hungarian databases and some from on-farm data.

In the required model calculation, I examined the effect of the determining factors, the average weight at the time of sale, the feed conversion ratio, and the changes in the feed and goose purchase prices. In the analysis, I considered fixed costs to

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[5] Mészáros S. (1981): Összefüggés-vizsgálatok. In: Alapismeretek az operációkutatáshoz (Szerk. Csáki Cs., Mészáros S.). Mezőgazdasági Kiadó. Budapest. 42. p.

[6] Pupos T. (2011): Az állattenyésztési ágazatok elemzése In.: Állattenyésztési ágazatok ökonómiája (Blaskó B. – Cehla B. – Kiss I. – Kovács K. – Lapis M. – Madai H. – Nagy A.Sz – Nábrádi A. – Pupos T. (szerk.) – Szőllősi L. – Szűcs I. (szerk.)). Debreceni Egyetem, Nyugat-Magyarországi Egyetem, Pannon Egyetem. pp. 24-37.

be specific cost items that are independent of the factors described above (energy costs, veterinary drug costs, services used, other costs, personnel costs, depreciation, ancillary operating costs and overheads). As a next step, I examined the main economic indicators of the activity (net income, average cost) as dependent variables, and I made cross-tabulations to illustrate the obtained results.

Table 1 summarizes the methods used in the research, as well as the rationale for their need and their areas of application.

Table 1. **Summary of the methods used in the research**

Method	Necessity/area of use
Problem tree analysis	Systematization of the problems of the sector, exploration of causal relations.
Time series analysis	Processing of secondary data, databases and primary data collected for modeling required for literature processing.
Descriptive statistical methods	Processing and evaluating the collected farm level primary data using descriptive statistical methods to characterize production with natural and economic data, and providing data for modeling.
Correlation analysis	Analysis of linear relationships between production parameters and average cost using correlation and regression analysis.
Modeling	Examination of the cost and income relations of the activity and the impact of the determining factors on economic indicators at the farm level.
Cost-benefit analysis	Economic evaluation of the results of the model at the farm level.
Cross-tabulation analysis	Analysis of the effect of changes in various economic and production parameters at the farm level.

Source: own construction

3. MAIN FINDINGS OF THE DISSERTATION

In line with the questions raised in relation to the objective, I would like to present the main findings of my research as follows.

1. How can the situation in the sector currently be described? What difficulties do the players in the sector face and what opportunities do they have?

This sector has centuries-old traditions, it is typically export-oriented and significant from the aspect of the Hungarian economy, and an important source of foreign exchange earnings. The players in the sector produce special products with high added value, which are also sought after and recognized in international markets. Nevertheless, the players in the sector face a number of challenges. The central problem of the sector is the decline in international competitiveness, which may lead to a further decline in market share *(Figure 1)*. In connection with this problem, the following problem areas have been identified that directly cause a competitive disadvantage for the players in the sector: lack of skilled labor, hectically changing profitability, decrease in the number of producers, low level of marketing in the sector, international exposure, growing competitors *(Figure 1)*.

The shortage of skilled labor is partly due to the fact that the current skilled workforce is aging and young people in the sector are in many cases forced to work in the sector because they may have no other option in the area. In addition, there is a further problem with the supply of skilled labor in the sector, which is caused by the lack of quality education and the lack of experience of those performing agricultural training. In addition, labor shortages in the sector, as well as large fluctuations, represent a problem. The profitability of the sector is changing in a hectic way, mainly due to changes in customer demand, seasonality and fluctuations in sales prices. The ability of the sector to generate income is significantly influenced by the price at which producers can sell their products, and the exchange rate is also significantly affected by its export orientation. An

important role in the change in income is played by the change in average cost, which is partly caused by the change in feed prices, which accounts for the largest share of costs. Additional costs due to the increasingly strict animal welfare, hygiene and food safety requirements also play a role from the aspect of profitability. Changes in wages and energy prices in recent years also have an impact on average cost. It is also important to mention the changing production efficiency, which is partly caused by the age and condition of buildings and partly by the many goose species involved in production, both of which can be attributed to a lack of resources.

The Hungarian goose sector is facing increasing competition, as Poland has been able to increase and develop its poultry and goose sector to such an extent that it is currently Hungary's largest competitor in international markets.

It is in the interest of the players in the sector to develop the sector, maintain its competitiveness and possibly increase it. In the future, they must strive for competitiveness, and the goal is to produce products that can be sold in markets where quality, safety and animal welfare is a requirement, and where there is increasing competition. Brand is also expected by consumers in relation to value-added products, and convenience products are becoming increasingly important. Consequently, it is becoming increasingly important to sell further processed products in addition to primarily processed, chopped products. For this reason, further developments are needed in the goose sector in addition to the developments of recent years.

In addition, another goal and future task may be to improve the marketing activities of the sector, to develop a marketing strategy in which quality and brand are emphasized through consumer expectations, and to offer quality products of the sector to consumers within the framework of a well-developed brand.

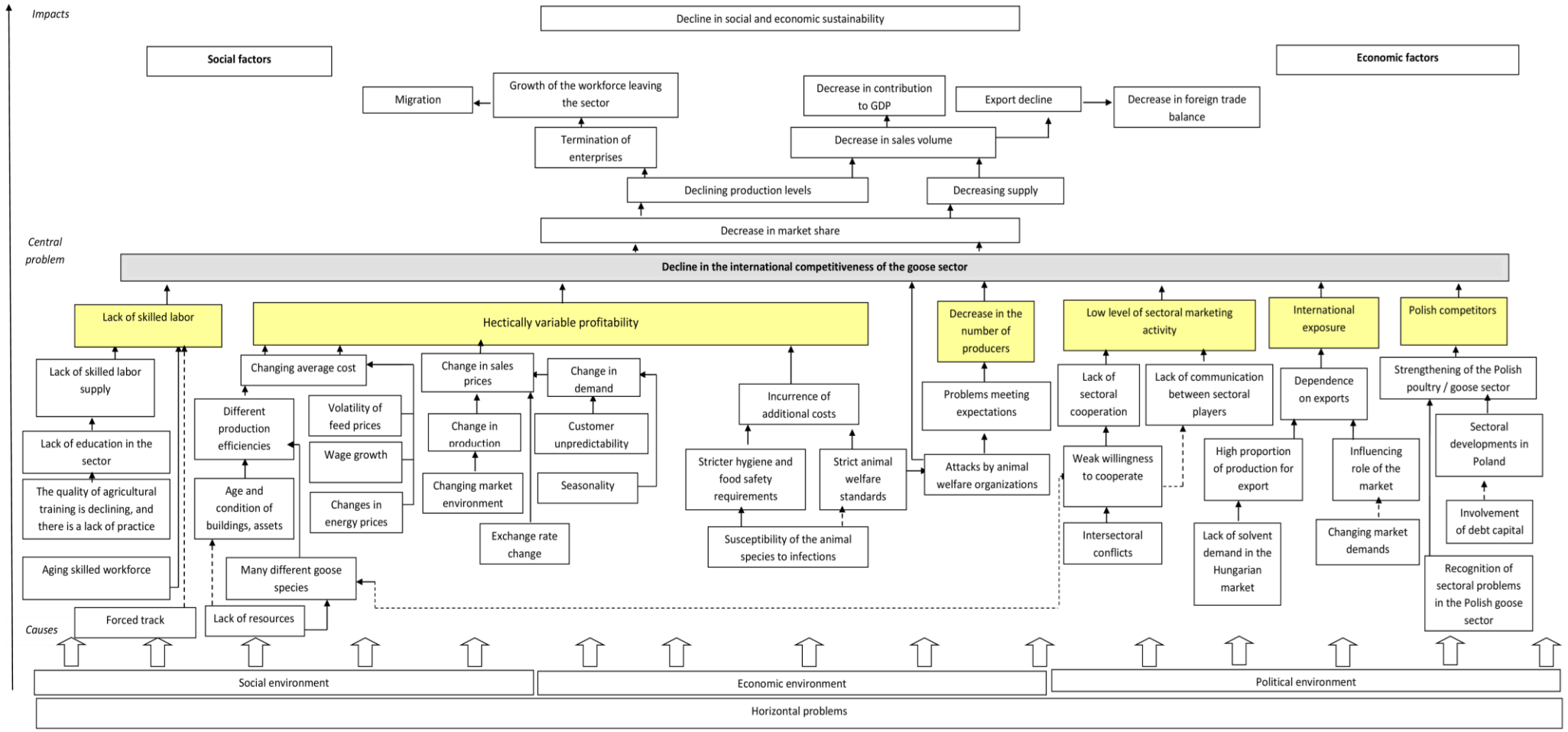

Figure 1. **The problem tree of the domestic goose sector**

Source: own construction

A further development direction for the sector is to solve the issue of stock breeding, to create a unified genetic background in the case of different purposes of production, which would help ensure a unified commodity base, and it is likely that production parameters could also be improved as a result. However, sectoral cooperation alone is not enough to achieve this goal, as the necessary resources are not available.

The players in the sector have no direct impact on some of the identified problems, as their solution goes beyond them. Thus, at the farm level, it is necessary to focus on problem areas that can be eliminated at the farm level. The issue of efficiency, thereby reducing average cost and improving profitability, is a farm-level task.

2. How to describe the natural inputs of goose meat production, the production costs and their structure under different production and technological standards and with different fattening periods? In this context, what is the level of output and what are the production indicators (output, feed conversion ratio, mortality, average daily weight gain, etc.)? And as a result, how do the results of farming and the efficiency of production develop?

To answer this question, a distinction must be made between 9-week-old and 14-week-old geese, and the different fattening periods need to be examined separately in terms of production indicators and cost-income ratios. National average data on the performance of the sector are not available, i.e. it is possible to answer the question on the basis of the data of the examined enterprise, thus the formulated conclusions apply to the given farms, but in some cases they can be generalized.

In the case of 9-week-old geese, it is possible to achieve 5.2 kg/pc average weight at the time of sale during the 60.7-day fattening period at 4.3% mortality in pre-rearing and 3.2% in post-rearing and 2.9 kg/kg of feed conversion ratio and an average daily weight gain of 85.0 g/day In contrast, in the case of 14-week-old geese, it is possible to achieve 5.8 kg/kg in 98.9 days, with mortality rates of 4.9% and 3.9% for pre- and post-rearing, respectively, 4.4 kg/kg FCR and an average daily weight gain of 58.4 g/day (*Table 2*).

Table 2. **Natural efficacy indicators of 9- and 14-week-old goose fattening for the rotations studied (2014-2018)**

Production indicator	**MU**	**9-week-geese** *(n=42)*	**14-week-geese** *(n=34)*	**Difference** *(14-weeks-9-weeks)*
Rearing period *(pre-rearing)*	*day*	23.50	23.33	-0.17
Rearing period *(post-rearing)*	*day*	37.26	75.59	38.33*
Rearing period *(pre- and post-rearing)*	*day*	60.76	98.91	38.15*
Feed use *(pre- and post-rearing)*	*kg/pc*	15.11	25.18	10.07*
Feed conversion ratio *(pre-rearing)*	*kg/kg*	1.64	1.63	-0.01
Feed conversion ratio *(post-rearing)*	*kg/kg*	3.70	5.72	2.02*
Feed conversion ratio *(pre- and post-rearing)*	*kg/kg*	2.93	4.36	1.43*
Average daily weight gain *(pre-rearing)*	*g/day*	88.32	82.30	-6.02*
Average daily weight gain *(post-rearing)*	*g/day*	83.65	51.31	-32.34*
Average daily weight gain *(pre- and post-rearing)*	*g/day*	85.02	58.44	-26.58*
Mortality *(pre-rearing)*	*%*	4.36	4.98	0.62
Mortality *(post-rearing)*	*%*	3.22	3.87	0.65
Average weight *(at the time of establishment)*	*kg/pc*	0.10	0.22	0.12
Average weight *(at the time of moving)*	*kg/pc*	2.10	2.07	-0.03
Average weight *(at the time of sale)*	*kg/pc*	5.16	5.75	0.59*

* Significant difference ($p<0.05$)

Source: own calculation based on company data

In the case of the production of 9-week-old geese, there was a significant difference between the values of the production indicators of different farms in terms of mortality in pre- and post-rearing, length of rearing period, average daily weight gain and average weight at the time of sale ($p<0.05$). In contrast, during the 14-week-old goose production, a statistically significant difference between the individual farms can be detected only in the case of the average daily weight gain.

The case of the production of 9-week-old geese, there was a significant difference between the production indicators of each year in only a few cases (average daily weight gain, pre-rearing duration). Consequently, these results can typically be achieved at the examined farms, even without further developments or changes. Furthermore, no development can be observed in such a short term, and it is

necessary to perform the studies on longer time series in order to assess the improvement of efficiency over time.

In the case of 14-week-old goose fattening, the production indicators of 2014 (rearing time, FCR, mortality in the post-rearing facility, average daily weight gain) are statistically different compared to the data of the other years. A significant difference ($p<0.05$) can be detected in the values of the individual years on several occasions in the case of the average daily weight gain of post-rearing and the average weight at the time of sale.

While the production of one kilogram of 9-week-old geese cost on average 429.0 HUF between 2014 and 2018, the average cost of producing 14-week-old geese was 506.6 HUF, which is about 18% higher than for 9-week-old geese. In contrast, there was a 9% difference in sales prices, i.e. the income from 9-week-old goose production was on average 101.4 HUF/kg, while the income from producing 14-week-old geese was about 30% lower, but still 70.7 HUF/kg *(Table 3).*

For both 9- and 14-week-old geese, material costs account for about 80-90% of production costs, which are determined by the cost of the day-old goslings and feed. These expenses accounted for 60-70% of the production costs for each farm, depending on whether the surveyed company placed a day-old gosling or a self-reared bird bought at a higher price in the given rotation. In the case of each rotation, birds were fattened with the farm's own feed, the cost of which is typically determined by the cost of the raw material of feed.

Over the entire fattening period, personnel costs represent 3-7% of the specific cost of production for each farm, while 5-7% on average for the rotations of all farms. Cost items such as energy, litter, veterinary medicine, services used and depreciation represent on average 1-3% of the cost of production per cost item, while other material costs, ancillary costs and overheads account for less than 1% each. The cost of litter is generally determined by the weather and the amount of day-old goslings, which greatly influences the amount of straw used as litter.

Table 3. **Cost-benefit ratios of 9- and 14-week-old goose production for the examined rotations**

MU.: HUF/kg

Description	**9-week-old goose** *(n=49)*	*(%)*	**14-week-old goose** *(n=40)*	*(%)*	**Difference** *(14-week-old-9-week-old)*
Material costs	376.6	87.8	421.0	83.1	44.35
Day-old goslings	156.9	36.6	138.3	27.3	-18.57
Feed	194.3	45.3	235.6	46.5	41.29
Energy	7.5	1.7	11.4	2.2	3.86
Litter	12.6	2.9	16.0	3.2	3.43*
Veterinary medicine	5.2	1.2	8.5	1.7	3.31*
Services used[1]	9.9	2.3	19.9	3.9	10.05
Other[2]	3.3	0.8	7.2	1.4	3.9
Personnel costs	21.0	4.9	36.9	7.3	15.91
Depreciation costs	10.8	2.5	12.2	2.4	1.39
Ancillary costs	5.3	1.2	7.9	1.6	2.64
Overheads	2.1	0.5	2.5	0.5	0.35
Total production costs	**429.0**	**100.0**	**506.6**	**100.0**	**77.57***
Sales price	530.4	-	577.3	-	46.85
Net income[3]	**101.4**	**-**	**70.7**	**-**	**-30.72***
Cost-related profitability (%)	25.2	-	14.9	-	-10.34*

[1] animal health and animal husbandry services, waste disposal, transport, loading costs, other services used, etc.
[2] parts, repair and maintenance, work clothes, cleaning agents, etc.
[3] without subsidies

*Significant difference ($p<0.05$)

Source: own calculation

The results obtained support the findings of the literature review chapter, i.e. production costs have increased significantly in the past year, due to, among other things, the increase in inputs, such as energy and the price of services used, and the forced increase in personnel costs. There is a significant difference between the values of each year in terms of the cost of day-old goslings in the case of the production of 9-week-old geese, and in the cost of services used in the production of 14-week-old geese. For both rearing periods, there is a significant difference between the yearly averages of energy costs, average costs, and cost-proportional profitability.

Examining the cost and income relations of 9-week-old goose fattening per farm, a statistically significant difference can only be detected between the values of personnel costs ($p<0.05$). Performing the same comparison during the production of 14-week-old geese, there are significant differences in energy costs, cost of services used and personnel costs in several cases, while in only a few cases in terms of cost, net income and cost-based income.

The technological level of the farms examined during the research could not be clearly identified, as there may be significant differences within the farms for each stable. Since the data was available at a rotation level, I could only evaluate and compare the performance of each farm. Thus, the significant difference detected as a result of statistical tests performed to compare the production indicators of the farms cannot be traced back to the technological differences.

In the case of different fattening times, I examined the differences in production parameters and the cost and income ratios of goose fattening. In the case of different rearing times, there was a statistically significant difference in the number of rearing days, the feed conversion ratio in post-rearing, as well as the average daily weight gain, total feed consumption and FCR ($p<0.05$).

In addition, comparing the specific costs and profitability of 9 and 14-week-old goose fattening per kilogram live weight, statistical tests show a difference between litter costs, veterinary medicine costs and average cost, as well as between net income and cost-proportional profitability ($p<0.05$).

Examining the change in results that can be achieved with the extra expenditure in the case of different fattening times, it can be stated that, while natural efficiency indicators (feed conversion ratio, daily weight gain) deteriorate with further fattening, the sales revenue per bird as well as the production cost partly improve due to the additional expenditures of the 9-14th weeks (*Table 4*).

Table 4: **Average and additional efficiencies in the production of 9- and 14-week-old geese**

Description	MU	9-week-geese	9-14th weeks[1]	14-week-geese
Daily feed intake per bird	*g/day/pc*	248,68	263,99	254,57
Average daily weight gain	*g/day*	84,93	15,47	58,13
Specific feed use	*kg/kg*	2,93	17,07	4,38
Live weight that can be produced with 1 kg of feed	*kg/kg*	0,34	0,06	0,23
Revenue per day per bird	*HUF/pc/day*	45,04	0,73	33,56
Production cost per day per bird	*HUF/pc/day*	35,69	1,34	29,45
Net income per day per bird	*HUF/pc/day*	8,61	-0,47	4,11
Revenue per day per kilogram	*HUF/kg/day*	8,73	1,23	5,84
Production cost per kilogram per day	*HUF/kg/day*	6,92	2,26	5,12
Net income per kilogram per day	*HUF/kg/day*	1,67	-0,80	0,71
Sales revenue with a production cost of 1 HUF	*HUF/HUF*	1,26	0,54	1,14
Sales revenue with a feed cost of 1 HUF	*HUF/HUF*	0,53	-0,55	0,29

[1] Values calculated from the average data of the data series.

Source: own calculation based on company data

The feed conversion ratio increases to 17.1 kg/kg between the 9th and 14th weeks, thus significantly deteriorating the FCR during the production of 14-week-old geese compared to 9 weeks of age. Furthermore, while the average daily weight gain in the first 9 weeks is 84.93 g/day, in the period of further fattening this value decreases significantly to about 15.47 g/day.

The results confirm the literature review, according to which the growth of the goose is the strongest in the first eight weeks and decreases with age. As a result, the average efficiency begins to deteriorate. The supplementary feed used between the 9th and 14th weeks results in a weight gain of 0.06 kg per kilogram.

It can also be stated that, while the sales revenue per 9-week-old goose is 45.04 HUF per day, an additional revenue of 0.73 HUF per bird can be achieved with each additional day of rearing.

If one examines the change in net income that can be achieved by the extra production cost, it can be concluded that a loss may be realized between the 9th and the 14th week, thus deteriorating the income-generating capacity of the activity in general. Extra expenditure typically did not mean additional results, did not cause any improvement in the values of additional efficiency, i.e. the average efficiency indicators do not improve with further fattening. Nevertheless, the market needs and the goose meat production ability justify further fattening, as the proportion of meat parts (thighs, breasts) that can be considered the most valuable according to consumer perception and their weight are significantly influenced by the age of the birds. Slaughterhouses determine the average weight at the time of sale based on market needs, all of which has an impact on the length of the rearing period. Since further fattening is not decided at the operational but at the product level, it is recommended to extend the tests.

Consequently, I confirm both **$H1_a$** *(The rearing time during goose meat production influences the production indicators characteristic of the activity, i.e. natural efficiency.)* and **$H1_b$** *(The rearing time used during goose meat production significantly influences the results of farming.)*.

3. How do changes in production and economic factors affect the economic performance of production, and what are the critical parameters of profitable production in terms of inputs, yields, and input and output prices?

Examining the correlations between the production indicators of goose fattening and the cost of the activity in the case of different fattening times, no significant linear relationship can be observed between the different production indicators and the average cost in relation to 9-week goose production ($p>0.05$). However, I believe that this does not mean that there is no relationship between these factors. Due to the fact that close correlations can be observed in other waterfowl sectors (MOLNÁR -

SZŐLLŐSI, 2017[7]), it can be assumed that a non-linear relationship also exists in the case of 9-week-old goose production. For this reason, in my opinion, it would be worthwhile to examine these relationships in additional samples, and it is recommended to examine the nonlinear relationship in the case of these data. In contrast, in the case of 14-week-old goose fattening, there was no relationship between the average cost and the average weight at the time of sale ($p>0.05$), however, a moderate or close linear relationship can be detected for the other variables. There is also a moderate correlation between the average weight at the time of sale and the feed conversion ratio, as well as the relationship between the cost and the number of rearing days, daily weight gain, total feed consumption, mortality and feed conversion ratio ($p<0.05$). Furthermore, a close correlation can be found between the average cost and several variables (average weight at the time of sale, feed conversion ratio, mortality and number of rearing days) ($R=0.780$, $p<0.05$).

Table 5. **Basic data of model calculations**

Description	MU	9-week-geese	14-week-geese
Population at the time of establisment	*no.*	20 350	23 000
Mortality	*%*	3.5	3.67
Average daily weight gain	*g/day*	85.0	58.4
Feed conversion ratio	*kg/kg*	2.93	4.36
Average weight at time of sale	*kg/pc*	5.16	5.75
Sales price	*HUF/kg*	532.6	557.3
Feed prices	*HUF/kg*	77.80	65.80
Price of day-old-goslings	*HUF/pc*	605.4	736.1

Source: own calculation

To examine the effect of production and economic indicators on the cost-income relations of the activity, I performed a model calculation based on the average input prices, cost items and production parameters of the company between 2014-2018, which I defined as the average of the values characteristic of each rotation.

[7] Molnár Sz. – Szőllősi L. (2017): Economic issues of duck production: a case study from Hungary. Apstract. 11 (3-4) pp. 61-68.

In contrast, in the case of sales prices, the average of HPPB's purchase prices for a given period was included. The basic data of the model calculation are illustrated in *Table 5* for the different production purposes.

Table 6 shows the 9-week and 14-week goose rotation levels, as well as their specific costs, sales revenue, and the income that can be realized as a result.

Table 6. **Cost and income ratios of fattening 9- and 14-week-old geese based on model calculation**

Description	9-week-geese			14-week-geese		
	Value *(thousand HUF /rotation)*	**Value** *(HUF/kg)*	**Share** *(%)*	**Value** *(thousand HUF /rotation)*	**Value** *(HUF/kg)*	**Share** *(%)*
Material costs	39 073.4	387.6	91.9	59 028.3	463.3	91.7
Cost of day-old-goslings	*12 340.2*	*122.2*	*29.0*	*16 930.3*	*132.9*	*26.3*
Cost of compound feed	*22 979.1*	*228.0*	*54.1*	*36 548.5*	*286.9*	*56.8*
Cost of electricity	*167.0*	*1.7*	*0.4*	*292.9*	*2.3*	*0.5*
Cost of gas energy	*467.8*	*4.6*	*1.1*	*618.2*	*4.9*	*1.0*
Cost of litter	*1 179.4*	*11.7*	*2.8*	*1 295.4*	*10.2*	*2.0*
Cost of veterinary medicine	*697.7*	*6.9*	*1.6*	*883.1*	*6.9*	*1.4*
Services used	*936.7*	*9.3*	*2.2*	*1 662.6*	*13.1*	*2.6*
Other costs	*305.2*	*3.0*	*0.7*	*797.3*	*6.3*	*1.2*
Personnel costs	1 822.5	18.1	4.3	2 743.9	21.5	4.3
Depreciation	928.8	9.2	2.2	1 605.2	12.6	2.5
Ancillary operating costs	461.9	4.6	1.1	875.5	6.9	1.4
Overheads	211.4	2.1	0.5	101.2	0.8	0.2
Total production costs	**42 497.7**	**421.6**	**100.0**	**64 354.1**	**505.1**	**100.0**
Sales revenue	53 759.7	533.3	-	70 998.0	557.3	-
Net income[1]	**11 262.0**	**111.7**	**-**	**6 643.9**	**52.2**	**-**
Cost - proportional profitability (%)	***26.5***	***26.5***	**-**	***10.3***	***10.3***	**-**

[1] without subsidies

Source: own calculation

The production costs of the 14-week-old goose are about 20% higher than those of 9-week-old geese, which corresponds in magnitude to the measurable differences in the actual data. This difference is partly due to differences in feed costs (26%), as despite the fact that the price of the feed mixture used for fattening 9-week-old geese

was on average 12 HUF higher than for 14-week-old geese, the amount of feed used for further fattening represents a significant additional cost. In the case of the other cost items, there is a similar difference between the two rearing periods, however, due to their smaller share, they have less influence on the production cost.

As a result of the performed model calculation, it can be concluded that, in the case of the 9-week-old goose and the possible combinations of sales and feed prices (ceteris paribus), if the sales price decreases to 460 HUF, a loss can be realized at 95 HUF/kg feed price, and the critical feed price is 90.9 HUF/kg (*Table 7*).

Table 7. **Net income as a function of feed price and sales price (9-week-old geese)**

Net income[1] *(HUF/kg)*		**Sales price** *(HUF/kg)*										
		460	**475**	**490**	**505**	**520**	**535**	**550**	**565**	**580**	**595**	**610**
Feed price (*HUF/kg*)	**50**	119.9	134.9	149.9	164.9	179.9	194.9	209.9	224.9	239.9	254.9	269.9
	55	105.2	120.2	135.2	150.2	165.2	180.2	195.2	210.2	225.2	240.2	255.2
	60	90.6	105.6	120.6	135.6	150.6	165.6	180.6	195.6	210.6	225.6	240.6
	65	75.9	90.9	105.9	120.9	135.9	150.9	165.9	180.9	195.9	210.9	225.9
	70	61.3	76.3	91.3	106.3	121.3	136.3	151.3	166.3	181.3	196.3	211.3
	75	46.6	61.6	76.6	91.6	106.6	121.6	136.6	151.6	166.6	181.6	196.6
	80	32.0	47.0	62.0	77.0	92.0	107.0	122.0	137.0	152.0	167.0	182.0
	85	17.3	32.3	47.3	62.3	77.3	92.3	107.3	122.3	137.3	152.3	167.3
	90	2.7	17.7	32.7	47.7	62.7	77.7	92.7	107.7	122.7	137.7	152.7
	95	-12.0	3.0	18.0	33.0	48.0	63.0	78.0	93.0	108.0	123.0	138.0
	100	-26.6	-11.6	3.4	18.4	33.4	48.4	63.4	78.4	93.4	108.4	123.4

[1] without subsidies
Source: own calculation

In addition, it can be stated that at a given sales price, an increase in the feed price by 1 HUF decreases net income by almost 3 HUF, while a deterioration in the value of unit feed consumption by 0.1 kg increases the average cost by 7.8 HUF at a given average weight at the time of sale (*Table 8*).

Table 8. **Average cost as a function of average weight at the time of sale and feed conversion ratio (9-week-old geese)**

Average cost *(HUF/kg)*		**Average weight at time of sale** *(kg/pc)*								
		4.2	**4.4**	**4.6**	**4.8**	**5.0**	**5.2**	**5.4**	**5.6**	**5.8**
Feed conversion ratio *(kg/kg)*	**2.5**	432.4	421.6	411.7	402.6	394.3	386.6	379.5	372.9	366.8
	2.6	440.2	429.4	419.5	410.4	402.1	394.4	387.3	380.7	374.5
	2.7	447.9	437.1	427.3	418.2	409.9	402.2	395.1	388.5	382.3
	2.8	455.7	444.9	435.0	426.0	417.7	410.0	402.9	396.3	390.1
	2.9	463.5	452.7	442.8	433.8	425.4	417.8	410.6	404.0	397.9
	3.0	471.3	460.5	450.6	441.5	433.2	425.5	418.4	411.8	405.7
	3.1	479.1	468.3	458.4	449.3	441.0	433.3	426.2	419.6	413.4
	3.2	486.8	476.0	466.2	457.1	448.8	441.1	434.0	427.4	421.2
	3.3	494.6	483.8	473.9	464.9	456.6	448.9	441.8	435.2	429.0
	3.4	502.4	491.6	481.7	472.7	464.3	456.7	449.5	442.9	436.8

Source: own calculation

Table 9. **Net income as a function of average weight at the time of sale and feed conversion ratio (9-week-old geese)**

Net income[1] *(HUF/kg)*		**Average weight at time of sale** *(kg/pc)*								
		4.2	**4.4**	**4.6**	**4.8**	**5.0**	**5.2**	**5.4**	**5.6**	**5.8**
Feed conversion ratio *(kg/kg)*	**2.5**	100.9	111.7	121.6	130.7	139.0	146.7	153.8	160.4	166.5
	2.6	93.1	103.9	113.8	122.9	131.2	138.9	146.0	152.6	158.8
	2.7	85.4	96.2	106.0	115.1	123.4	131.1	138.2	144.8	151.0
	2.8	77.6	88.4	98.3	107.3	115.6	123.3	130.4	137.0	143.2
	2.9	69.8	80.6	90.5	99.5	107.9	115.5	122.7	129.3	135.4
	3.0	62.0	72.8	82.7	91.8	100.1	107.8	114.9	121.5	127.6
	3.1	54.2	65.0	74.9	84.0	92.3	100.0	107.1	113.7	119.9
	3.2	46.5	57.3	67.1	76.2	84.5	92.2	99.3	105.9	112.1
	3.3	38.7	49.5	59.4	68.4	76.7	84.4	91.5	98.1	104.3
	3.4	30.9	41.7	51.6	60.6	69.0	76.6	83.8	90.4	96.5

[1] without subsidies
Source: own calculation

During the production of the 14-week-old goose, the deterioration of the FCR by 0.1 kilograms increases the cost by 6.6 HUF. Based on the obtained results, it can be stated that in the case of the 14-week fattening period, the production is already unprofitable at a sales price of 500 HUF/kg and a feed price of 65 HUF/kg. As a result, in addition to the highest feed prices, a sales price over 654.3 HUF/kg is needed for the activity to be profitable. At a given sales price, if the price of feed increases by 1 HUF, the net income decreases by 4.4 HUF (*Table 10*).

Table 10. **Net income as a function of feed price and sales price (14-week-old geese)**

Net income[1] *(HUF/kg)*		**Sales price** *(HUF/kg)*										
		500	**510**	**520**	**530**	**540**	**550**	**560**	**570**	**580**	**590**	**600**
Feed price *(HUF/kg)*	**50**	63.7	73.7	83.7	93.7	103.7	113.7	123.7	133.7	143.7	153.7	163.7
	55	41.9	51.9	61.9	71.9	81.9	91.9	101.9	111.9	121.9	131.9	141.9
	60	20.1	30.1	40.1	50.1	60.1	70.1	80.1	90.1	100.1	110.1	120.1
	65	-1.7	8.3	18.3	28.3	38.3	48.3	58.3	68.3	78.3	88.3	98.3
	70	-23.5	-13.5	-3.5	6.5	16.5	26.5	36.5	46.5	56.5	66.5	76.5
	75	-45.3	-35.3	-25.3	-15.3	-5.3	4.7	14.7	24.7	34.7	44.7	54.7
	80	-67.1	-57.1	-47.1	-37.1	-27.1	-17.1	-7.1	2.9	12.9	22.9	32.9
	85	-88.9	-78.9	-68.9	-58.9	-48.9	-38.9	-28.9	-18.9	-8.9	1.1	11.1
	90	-110.7	-100.7	-90.7	-80.7	-70.7	-60.7	-50.7	-40.7	-30.7	-20.7	-10.7
	95	-132.5	-122.5	-112.5	-102.5	-92.5	-82.5	-72.5	-62.5	-52.5	-42.5	-32.5
	100	-154.3	-144.3	-134.3	-124.3	-114.3	-104.3	-94.3	-84.3	-74.3	-64.3	-54.3

[1] without subsidies

Source: own calculation

Based on the data in *Table 11*, it can be stated that the average cost changes differently with the different combinations of the average weight at the time of sale and the feed consumption, and, as a result, the change of production parameters significantly affects the realizable income of the activity. It can be observed that, at a given average weight at the time of sale, the deterioration of the FCR value by 0.1 kilograms increases the cost by 6.6 HUF.

Table 11. **Average cost as a function of average weight at the time of sale and feed conversion ratio (14-week-old geese)**

Average cost *(HUF/kg)*		**Average weight at time of sale** *(kg/pc)*								
		5.2	**5.4**	**5.6**	**5.8**	**6.0**	**6.2**	**6.4**	**6.6**	**6.8**
Feed conversion ratio *(kg/kg)*	**3.2**	451.9	443.0	434.7	426.9	419.7	413.0	406.7	400.7	395.1
	3.4	465.1	456.1	447.8	440.1	432.9	426.1	419.8	413.9	408.3
	3.6	478.2	469.3	461.0	453.3	446.0	439.3	433.0	427.0	421.4
	3.8	491.4	482.4	474.1	466.4	459.2	452.5	446.1	440.2	434.6
	4.0	504.5	495.6	487.3	479.6	472.4	465.6	459.3	453.4	447.8
	4.2	517.7	508.8	500.5	492.7	485.5	478.8	472.5	466.5	460.9
	4.4	530.9	521.9	513.6	505.9	498.7	491.9	485.6	479.7	474.1
	4.6	544.0	535.1	526.8	519.1	511.8	505.1	498.8	492.8	487.2
	4.8	557.2	548.2	539.9	532.2	525.0	518.3	511.9	506.0	500.4
	5.0	570.3	561.4	553.1	545.4	538.2	531.4	525.1	519.2	513.6
	5.2	583.5	574.6	566.3	558.5	551.3	544.6	538.3	532.3	526.7
	5.4	596.7	587.7	579.4	571.7	564.5	557.7	551.4	545.5	539.9
	5.6	609.8	600.9	592.6	584.9	577.6	570.9	564.6	558.6	553.0

Source: own calculation

In the case of both production purposes, average cost changes differently with the different combinations of the average weight at the time of sale and the feed consumption, i.e. the change of these production parameters significantly affects the realizable income of the activity (*Tables 9 and 12*). Consequently, the income of the activity can be significantly increased by improving these factors, and this represents, among other things, the reserves at the farm level that affect competitiveness. My suggestions for improvement are set out in connection with *Question 4*.

Table 12. **Net income as a function of average weight at the time of sale and feed conversion ratio (14-week-old geese)**

Net income[1] *(HUF/kg)*		**Average weight at time of sale** *(kg/pc)*								
		5.2	**5.4**	**5.6**	**5.8**	**6.0**	**6.2**	**6.4**	**6.6**	**6.8**
Feed conversion ratio *(kg/kg)*	**3.2**	105.4	114.3	122.6	130.4	137.6	144.3	150.6	156.6	162.2
	3.4	92.2	101.2	109.5	117.2	124.4	131.2	137.5	143.4	149.0
	3.6	79.1	88.0	96.3	104.0	111.3	118.0	124.3	130.3	135.9
	3.8	65.9	74.9	83.2	90.9	98.1	104.8	111.2	117.1	122.7
	4.0	52.8	61.7	70.0	77.7	84.9	91.7	98.0	103.9	109.5
	4.2	39.6	48.5	56.8	64.6	71.8	78.5	84.8	90.8	96.4
	4.4	26.4	35.4	43.7	51.4	58.6	65.4	71.7	77.6	83.2
	4.6	13.3	22.2	30.5	38.2	45.5	52.2	58.5	64.5	70.1
	4.8	0.1	9.1	17.4	25.1	32.3	39.0	45.4	51.3	56.9
	5.0	-13.0	-4.1	4.2	11.9	19.1	25.9	32.2	38.1	43.7
	5.2	-26.2	-17.3	-9.0	-1.2	6.0	12.7	19.0	25.0	30.6
	5.4	-39.4	-30.4	-22.1	-14.4	-7.2	-0.4	5.9	11.8	17.4
	5.6	-52.5	-43.6	-35.3	-27.6	-20.3	-13.6	-7.3	-1.3	4.3

[1] without subsidies
Source: own calculation

Based on the obtained findings, I could partly confirm hypothesis **H2$_a$** *(The production indicators characteristic of goose meat production (feed conversion ratio, average daily weight gain, mortality) have a significant effect on the prime cost.)*, since, based on the available data, I was able to show the correlations between the production indicators and the cost price only in the case of 14-week-old geese. In contrast, I confirmed hypothesis **H2$_b$** *(The production indicators characteristic of goose meat production (feed conversion ratio, average daily weight gain) have a significant impact on the income of the activity.)*.

4. What operational-level reserves affecting competitiveness characterize the sector, and under what conditions can they be used?

It is possible to improve the profitability of the activity, and thus the competitiveness at the farm level, by increasing the production value or the sales revenue, by reducing the production costs, or by increasing the production costs to such an extent that it results in a higher increase in revenues. There are two ways to increase sales. On the one hand by raising purchase prices, which is not possible at the farm level, as producers occupy a price-accepting position in the market, and on the other hand by increasing the live weight sold, which is possible at the farm level. The average weight at the time of sale is typically determined by the rearing period and the intensity of growth. Since the average weight is typically decided by the slaughterhouse on the basis of market needs, it is necessary to examine the possibility of improving the average weight at the farm level with a given fattening time. Thus, increasing the average weight can be achieved by increasing the growth intensity, improving the average daily weight gain, which, however, is influenced by several factors such as technical and technological standards and expertise through management decisions. With a given feed intake, weight gain can be increased by improving FCR, to which the feed composition is a contributing factor, which I did not examine during my research, however, I suggest further research to explore the effect of this factor.

In reducing production costs, one of the tasks is to improve feed conversion ratio, the production indicator that has the greatest impact on it. Since feed costs account for a significant portion of total costs, it is important to know how much feed is needed to produce one kilogram of goose meat. It is possible to reduce the FCR on the one hand by improving the average daily weight gain, since in this case a higher live weight can be achieved with a given feed intake. On the other hand, the composition of the feed can also have an effect on the indicator, as long as the same live weight can be achieved with less feed intake.

Even mortality is an important production indicator for the profitability of goose meat production, which, on the one hand, has an impact on yields, and, consequently, on the sales revenue per unit of barn area and at farm level, and on the other hand, costs related to dead animals (e.g. day-old-goslings, feed) increase average cost.

Mortality, weight gain, and feed intake are also affected by a number of other factors, such as the quality of day-old-goslings, animal health issues, or the technology used.

I did not study the effect of improving these factors, i.e. it is recommended to continue the research, as the results showed that they significantly affect the income of the activity, and, as a result, its competitiveness, therefore, these studies have a raison.

It is also important to note that since the indicators are affected by genetic background, it would be necessary to develop a uniform, internationally competitive genetic background for the different production purposes, but we have seen that there is the producer collaboration is not enough and the solution points beyond the farm level.

At the farm level, the obtained results can be further influenced by the age and condition of the buildings and equipment. Despite the fact that these findings cannot be justified concerning the available data, I believe that the technological level and possible backwardness of the buildings involved in production may lead to a further increase in production costs, which may cause a decrease in income. Thus, in my opinion, the results of the activity, and its competitiveness, can be improved with possible improvements.

I also recommend the examination of consumer habits and preferences, as they significantly influence the length of the fattening period and the development of the average weight at the time of sale. Based on the obtained results, it can be stated that the production of 9-week-old geese is more efficient, but based on market needs, there is a higher demand for valuable pieces of meat (thighs, breasts), which are more favorable in size in the case of 14-week-old geese.

4. NEW AND NOVEL RESULTS OF THE DISSERTATION

The main objective of the dissertation was to explore the factors determining the farm-level competitiveness of 9- and 14-week-old goose fattening, and to determine any existing reserves. By achieving the objectives, I identified the following new and novel results:

1. I examined the situation of the Hungarian goose sector and determined and placed its problems in a structured system, explored the causal relationships between them, and identified which of them can be influenced at the farm level.
2. In the case of different fattening times, I determined the value, cost and income ratios of the natural efficiency indicators characteristic of the activity in 2014-2018 on the basis of farm line data, in relation to the prevailing economic circumstances. In addition, I outlined the structure of the production cost and presented the differences between the production and economic indicators characteristic of the production of 9- and 14-week-old geese.
3. I found that, in the case of the production of 9-week-old geese, based on the available data, no significant linear relationship can be detected between the production indicators and the average cost, which, however, does not mean that there is no relationship between these factors. In contrast, the fattening of 14-week-old geese showed a moderate relationship between the average weight at the time of sale and the feed conversion ratio, as well as the average cost with the number of rearing days, daily weight gain, total feed consumption, mortality and feed conversion ratio. There is a close linear relationship between several variables (average weight at the time of sale, feed conversion ratio, mortality and number of rearing days) and average cost.
4. I determined the effect of changes in the factors influencing the cost and income relations of the activity on economic indicators in the case of different fattening times.

5. PRACTICAL APPLICABILITY OF THE RESULTS

Since studies on the Hungarian goose sector, including the meat production purpose, are not available, similarly to farm competitiveness, as well as the economic analysis of meat-producing geese fattening, I consider the performed sectoral analysis, problem analysis and farm-level analyses to be especially significant.

The results obtained contribute to the understanding of the current situation, future challenges and opportunities of the sector, and provide guidance to the players of the sector in terms of further research directions and possible developments.

The results of the research in the field of business economics are expected to help the main professional organizations representing the Hungarian goose sector in seeing clearly and in the preparation of sectoral operational development plans.

In the field of education, the results of the dissertation contribute to the widening of knowledge taught in connection with the business economics analysis of the agricultural sectors based on the traditions of the Debrecen School of Business Administration, and can be incorporated into in the curriculum of its subjects.

In addition, I consider it necessary to carry out further research to determine the extent to which the applied technological level (age, condition, equipment of the buildings) influences the income-generating capacity of the activity.

6. PUBLICATIONS ON THE TOPIC OF THE DISSERTATION

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List of publications related to the dissertation

Articles, studies (11)

1. **Molnár, S.**, Szőllősi, L.: A libahizlalás naturális és ökonómiai hatékonysága eltérő nevelési idő esetén.
   Acta Carolus Robertus. 9 (1), 157-169, 2019. ISSN: 2062-8269.
   DOI: http://dx.doi.org/10.33032/acr.2019.9.1.157
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