

Thesis of doctoral (PhD) dissertation

**ECONOMIC AND SOCIAL ANALYSIS OF THE
SUSTAINABILITY AND COMPETITIVENESS OF THE
HONEY PRODUCT CHAIN IN HUNGARY**

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1. BACKGROUND, OBJECTIVES AND HYPOTHESES OF THE RESEARCH,

Beekeeping in Hungary is considered a relatively small sector, yet it plays a significant role in maintaining biodiversity, rural employment and food production. Beekeepers around the world, including in Hungary, face similar challenges, many of which threaten the competitiveness and sustainability of the sector. For example, there is an increasingly urgent need to combat honey adulteration, improve bee health and operate a comprehensive producer database and monitoring system. To ensure the sustainability of the beekeeping sector, good agricultural practices need to be applied, and effective measures need to be taken to preserve biodiversity. If the situation in the sector stabilises, the long-term sustainability and ecological importance of beekeeping can be preserved, and the rural population in honey-producing countries can be strengthened. However, this requires a complex analysis of the current situation of beekeepers in the sector, from production bases and production results, through the problems and opportunities faced by producers, to the vision outlined by beekeepers for the future.

Honey is an important export product and a source of income for Hungarian producers, and the sector's production activities contribute to increasing the yields of arable crops and horticulture, play a role in rural employment, environmental protection and landscape conservation (NAGY, 2007; TAKÁCS and OLÁH, 2017). From an economic point of view, the main purpose of beekeeping is to produce honey and other bee products, providing income and livelihoods for beekeepers and generating significant export revenues, as a large part of Hungarian honey production is sold abroad, thus playing a role in the development of macroeconomic indicators. At the same time, beekeeping, which is predominantly small-scale in Hungary, provides a source of supplementary income for families living in rural areas.

In 2023, there were more than 20,000 beekeeping operations in Hungary, keeping a total of more than 1.1 million bee colonies (NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION, 2024_A). Honey production in Hungary varies greatly from year to year, as it is influenced by several factors that have a fundamental impact on the yield that can be achieved in a beekeeping season. Among these, the bee health situation, changeable weather conditions, the decline in traditional honey sales opportunities and the high volatility of sales prices have been of particular importance in recent years. According to some studies, the high winter losses suffered by beekeepers were caused by the excessive presence of the Asian honey bee mite (*Varroa destructor*) and the physiological effects of poor-quality pollen due to dry weather (BRODSCHNEIDER and CRAILSHEIN, 2010; GORLOV et al., 2020; FEKETÉNYÉ FERENCZI, 2023_{A-C}). Recognising and managing these factors requires beekeepers to have thorough professional knowledge and time. According to the latest NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION survey, winter bee losses in Hungary in 2024 affected 46% of the bee population among part-time beekeepers and 31% of the bee population of full-time beekeepers, which is significantly higher than the 10-20% rate in recent years (NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION, 2025_A). The NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION survey identified bee health problems (e.g. inadequate mite control,

insufficient time devoted to this), weather factors (e.g. dry summer, prolonged autumn, mild winter) and low honey prices (e.g. honey not extracted due to sales difficulties, low feed replacement) as the main reasons.

According to numerous studies (ORAVECZ and SEDIK, 2022; ORAVECZ and SEDIK, 2023_{A-C}; VIDA and FEKETÉNÉ FERENCZI, 2023), Hungarian honey consumption is steadily increasing, so instead of exporting honey in barrels, the focus should be on selling Hungarian products with higher added value, using appropriate marketing strategies. Widespread cooperation between sectoral actors has not yet been achieved in Hungary (NAGY, 2007), although beekeepers are currently in great need of its potential benefits, and its absence causes a further competitive disadvantage. Cheap imports, which in many cases do not meet Hungarian and European standards for natural honey, further hamper the sector's current prospects, and from the producers' point of view, there is still no effective solution to this problem. Due to shortcomings in EU market regulation, the competitiveness of Hungarian honey has declined sharply. The persistence of these problems, both in the short term (e.g. decline in profitability, reduction in the number of bee colonies) and in the long term (e.g. lack of generational change, permanent closure of apiaries) has serious consequences for individual producers and the sector as a whole. As the title of my thesis suggests, my research sought to identify the factors that currently threaten the sustainability of beekeeping and honey production as an economic activity in Hungary and the competitiveness of the honey product chain. There is a lack of in-depth, producer-level research and detailed analysis of the current situation of the Hungarian beekeeping sector. Based on this, I thought that the most appropriate approach would be to collect up-to-date and reliable data through research methods based directly on interviews with beekeepers. Hungarian beekeeping is very diverse in terms of technology (e.g. hive type, frame size, transhumance), farm size (based on the number of bee colonies) and the types of honey produced. The starting point for my research, following a review of the literature, was to provide a structured description of this diversity and explore the interrelationships between the various factors. Finally, based on this, I formulated the current challenges facing the sector.

The main objectives of the research

Beekeeping is practised all over the world and is one of the oldest forms of agriculture. In Hungary, the high number of beekeepers and bee colonies they look after means that, despite being a small agricultural sector, relatively many people are involved in beekeeping, either full-time, part-time, as pensioners or as a hobby. The sector faces several challenges, one of the most serious being the *critical bee health situation* (NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION, 2025_A) and the fact that *Hungarian beekeepers selling honey in bulk to buyers are heavily dependent on export opportunities*. Hungarian direct sales to consumers account for about half of honey sales in large quantities (MINISTRY OF AGRICULTURE, 2019).

According to the president of the Hungarian Beekeepers' Association (NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION), the Hungarian honey market has virtually collapsed from the producers' point of view (BROSS, 2025). The sector has been in crisis since 2021-2022 and is currently experiencing a period of crisis. Export opportunities have narrowed, cheap imports have pushed Hungarian-produced

honey out of the market, primarily in European export markets, honey purchases have been suspended, and falling purchase prices are causing *serious profitability problems* for Hungarian beekeepers. This situation is further exacerbated by problems such as bee health, *the emergence of new pests* (e.g. the Asian hornet (*Vespa velutina nigrithorax*)) and *weather anomalies caused by climate change*. Representatives of the profession therefore predict a significant decline in the number of beekeepers and bee colonies in the longer term, which could have a serious negative impact on agricultural production due to the reduction in pollination provided by bees.

In connection with the above, the main objective of the research is to explore the technological level of Hungarian honey production, the current conditions of production, the factors affecting production, the factors determining yields and income-generating capacity, as well as problems at the sectoral and farm level. In relation to my objective, I seek to provide scientifically sound answers to the following questions:

- **Q1:** What characterises the technological level and structure of production at the apiary level?
- **Q2:** How are apiary performance and production efficiency developing?
- **Q3:** What are the problems at the farm level that characterise beekeeping in Hungary?
- **Q4:** What parameters characterise sales channels and support opportunities?
- **Q5:** What problems affecting competitiveness and sustainability characterise the Hungarian beekeeping sector, and how can the prospects for beekeeping be defined in this context?

Based on the literature review and expert opinions, and in relation to the objectives and research questions, I have formulated the following hypotheses:

- **H1:** The main reason for the low level of efficiency in Hungarian honey production is the backwardness of production technology.
- **H2:** The average honey yield increases in proportion to the farm size.
- **H3:** There is a positive correlation between professional knowledge and average honey yield.
- **H4:** Higher average honey yields can be achieved with transhumance technology using horizontal and vertical hives.
- **H5:** As farm size increases, the importance of honey sales through short supply chains decreases.
- **H6:** Honey adulteration is a factor that significantly limits the competitiveness of the Hungarian beekeeping sector.
- **H7:** Beyond economic factors, the sustainability of the Hungarian beekeeping sector is largely determined by its ability to adapt to the SDG goals¹.

¹ Sustainable Development Goals (UN Sustainable Development Goals)

According to HORVÁTH (2001), Hungarian honey production requires less labour for vertical hives than for horizontal hives, but according to NYÁRS (2001; 2003) and NAGY (2007), around the 2000s, several types of hives were in use, the vast majority of which were the large Boczonádi type, which has the disadvantage that certain activities are difficult to mechanise and are therefore very time-consuming and labour-intensive (H1).

According to calculations by FEKETÉNYÉ FERENCZI et al. (2021_{A-B}; 2023_{A-B}), one of the main factors determining the profitability of beekeeping is the honey yield per bee colony. According to calculations by the MINISTRY OF AGRICULTURE (2016; 2019), a professional apiary (with more than 150 bee colonies) practising migratory beekeeping can achieve a 50% higher honey yield than an average beekeeping operation (H2).

In some regions of Asia (CHANTAWANNAKUL 2022; KUMAR et al., 2024) and Africa (SIBAJA et al., 2025), specific honey yields are extremely low due to rudimentary beekeeping practices. According to BLANC et al. (2018), beekeeping practices vary greatly, and the expertise of beekeepers is a decisive factor in the success of beekeeping (ÖRÖSI, 1967; FALUBA, 1983; VICZE, 1997; NAGY, 2007) (H3).

According to a survey by the Hungarian Central Statistical Office (CENTRAL STATISTICAL OFFICE, 2012), approximately 70% of Hungarian beekeepers migrate to bee pastures to achieve higher yields, and transhumance is a particularly important beekeeping practice in the EU-27 Member States (EUROPEAN COMMISSION, 2023). According to ÖRÖSI (1967) and HORVÁTH (2001), the primary purpose of bee transhumance is to achieve higher honey yields. Fundamental technological questions include the type of hive and whether migratory or stationary beekeeping is practised, as well as the size of the bee population, as these characteristics determine the yield of the activity (H4).

A characteristic feature of Hungarian honey sales is that the majority is sold by beekeepers to buyers (MINISTRY OF AGRICULTURE, 2019; ORAVECZ et al., 2020_{A-B}), with direct sales, i.e. sales through a short supply chain, accounting for only 30% (MINISTRY OF AGRICULTURE, 2019). According to NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION (2024_B) records, this proportion was 25% in 2004 and 40% in 2024. Approximately 7% of Hungarian apiaries have more than 150 bee colonies (MINISTRY OF AGRICULTURE, 2019; ORAVECZ et al, 2020_A), meaning that the vast majority of Hungarian beekeepers have fewer than 150 bee colonies (H5).

According to BOSE and PADMAVATI (2024), the global honey market faces serious challenges such as honey adulteration, which is an unfair practice that affects the price and quality of honey, endangers consumer health and undermines the competitiveness of beekeepers. One of the most significant threats to the beekeeping sector is the large proportion of honey of "doubtful origin" imported into the European Union, which is classified as adulterated according to EU nomenclature and comes mainly from China (EUROPEAN PARLIAMENT, 2018). FEKETÉNYÉ FERENCZI et al. (2023_{B-C}) believe that combating honey adulteration will be a major challenge for the Hungarian beekeeping sector in the future (H6).

According to VAN ESPEN et al. (2023), European beekeepers need to be flexible in their decisions and adapt to change. GÁTHY and KUTI (2006) believe that to strive for a more sustainable future and remain competitive, farmers must adapt to the challenges of a constantly changing global environment. According to MUCHA et al. (2024), well-trained, long-established beekeepers find it much easier to overcome the difficulties caused by beekeeping problems (H7).

2. DATABASE AND APPLIED METHODS

The research included both primary and secondary data and information collection. In the first part of the chapter, I present the process and methodology of collecting the databases and literature used in the secondary data collection, followed by a description of the circumstances and methodology of the primary research.

2. Databases and methods used in secondary research

I began my research by collecting and analysing secondary theoretical and statistical sources and reviewing international and Hungarian literature to gain a broader understanding of the topic, which I then organised and analysed. In addition to reviewing relevant literature on the topic, the data used in the analysis (honey production and trade, number of bee colonies) were obtained from various databases, such as FAOSTAT (*Food and Agricultural Organization of the United Nations*), EUROSTAT (*Statistical Office of the European Communities*), COMTRADE (*International Trade Statistics Database*), WITS (*World Integrated Trade Statistics*), and, from Hungarian sources, MINISTRY OF AGRICULTURE, NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION and CENTRAL STATISTICAL OFFICE databases. I used the Web of Science, Scopus and ScienceDirect platforms to search for international literature. I used data and time series analysis to illustrate the functioning of the honey market and the main trends observed in the beekeeping sector at international, European Union and Hungarian levels, focusing on production, trade, external factors and the production bases of the sector (technology, farm size, yield, inputs, profitability). During the secondary research, I considered it important to present the beekeeping sector in an international context to better interpret the challenges faced by Hungarian producers. I collected some of the necessary data and information from international and Hungarian statistical databases, sectoral professional materials, data provided by interprofessional organisations, their statutes and professional articles for the last two decades to explore the causal relationships. My secondary research examined honey production and trade within the beekeeping sector at global, European Union and national economic levels, as well as honey consumption in a Hungarian context. To present the situation of beekeeping in Hungary, I relied on the databases of the NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION and the CENTRAL STATISTICAL OFFICE for the sector analysis, as well as on previously published works by Hungarian authors on the beekeeping sector (doctoral theses, sector analyses, specialist books) and scientific articles. It is important to note that, in the Hungarian context, the CENTRAL STATISTICAL OFFICE database contains aggregated data on honey production, trade and consumption, while more detailed data was provided for my research by the NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION, as an interprofessional and sectoral interest group. In addition to primary research about beekeeping, the literature sources also formed the basis for the sectoral problem analysis.

I considered data from a two-decade period between 2004 and 2023, using the latest available data for each year. In the case of the European Union, the data were interpreted for the 27 Member States.

2. Methodology of primary data collection and processing

To answer the research questions in a scientifically rigorous manner, I used both quantitative and qualitative methods in the primary data collection. One of the most used methods for producing data that can be quantitatively analysed is primary survey data collection (SIMON et al., 2024). In this case, large amounts of quantifiable information are collected, which can then be analysed using mathematical and statistical methods, allowing the data obtained from individual respondents to be aggregated and consistent conclusions to be drawn about the population (HÉRA and LIGETI, 2014). Qualitative methods are used to answer questions about experiences, reports and perspectives, most often from the participant's point of view. Qualitative research techniques include interviews, which can be used to obtain opinions and background information on a specific topic, i.e. to examine specific situations (HAMMARBERG et al., 2016). Qualitative research generally contains data in the form of words rather than numbers (PUNCH, 2013).

Among the quantitative methods, I chose questionnaire surveys, while among the qualitative methods, I chose expert interviews and, as an alternative qualitative research method, the use of "Grounded Theory" (HORVÁTH and MITEV, 2023).

2.2. Methodology of the questionnaire survey

Within the framework of quantitative data collection, I used a questionnaire survey conducted among Hungarian beekeepers, using random (probability) sampling. The questionnaire I compiled served as the basis for this. The aim of the survey was to assess the sustainability of the Hungarian beekeeping sector.

The questionnaire contained 39 questions, which referred to the types of honey produced, yields achieved and sales channels for the year 2022. The questions included closed questions, simple multiple-choice questions, ranking questions and scale questions (7-point Likert scale). In the case of the Likert scale, different statements can be evaluated on a scale defined between two extreme ends, which is usually scored from 1 to 5 or 1 to 7 (ZERÉNYI, 2016). In contrast to the 1-7 scale used for these questions, I defined a scale ranging from -3 to +3 to clearly highlight the difference between the possible answers to a given question. In addition, the odd number of degrees allows for a neutral position to be taken between the intermediate answers. The other group of questions consisted of open-ended questions, which I used to explore the respondents' opinions on the given question in more detail from their own perspective.

The questionnaire included questions on the size of the apiary, its technological characteristics, its general operation, the yields of the types of honey produced, the structure of its turnover, its sales channels and any sales difficulties. This was followed by questions on the use of bee pastures, pollination services and the usefulness of beekeeping, questions related to NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION membership and, finally, questions on measures against honey adulteration. At the end of the questionnaire, I included questions aimed at examining the background variables of the respondents

(age, beekeeping generation, type of activity, professional experience, educational attainment, and professional qualifications).

The questionnaire was validated through preliminary testing with the participation of NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION experts and five beekeepers (one of whom was a bee health officer). The survey covered beekeepers in 19 counties of Hungary and Budapest. The questionnaire was completed between March 2023 and September 2024, either online or on paper. I created the online version of the questionnaire using the professional questionnaire editor LimeSurvey. The participation of the respondents was entirely voluntary and anonymous. I reached the beekeepers with the help of NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION by distributing the questionnaire in paper form at beekeepers' meetings among the association's members and by publishing it online on the association's website, where it was also accessible to non-members. A total of 1,313 questionnaires were received because of online and paper-based responses. During the processing of the responses received, I excluded 246 questionnaires from the research due to irrelevant answers. Based on this, the number of responses used for the evaluation of the questionnaire survey was 1,067.

To determine the sample size, I used the following calculation for a finite population (LWANGA et al. 1991; KERÉKGYÁRTÓ et al., 2017), where $N=20,945$ is the number of beekeepers in Hungary (2022), Z -value is 1.96 at a 95% confidence level, and $p=0.5$ is the expected margin of error of 5% ($E=0.05$):

$$n = \frac{N * Z^2 * p * (1 - p)}{E^2 * (N - 1) + Z^2 * p * (1 - p)}$$

Taking into account a 10% non-response rate, the minimum sample size for evaluating the results is 440 individuals.

I was only able to assess representativeness in terms of the geographical location of apiaries and bee colonies, as no records are available for other criteria. According to the NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION database (2022), the sample is not representative of the geographical distribution of apiaries by county ($\chi^2=100.63$, $df=19$, $p<0.001$) or of the number of bee colonies by county ($\chi^2=116.17$, $df=19$, $p<0.001$). Thus, my results are only valid for the database, limiting their generalisability. However, it should be noted that, based on my objectives, my research refers to a population for which no data from other sources are available. Based on the responses received, the sample size is sufficient for evaluating the results. Since not all questions received the same number of responses, I have indicated the number of responses in each case during the analysis.

During the processing of the data, I identified five main areas and evaluated the results according to this structure. In the first stage, I evaluated the development of beekeeping technology and specific yields, and in the second stage, I evaluated the responses related to transhumance. The third area was sales channels and beekeeping subsidies, the fourth was the examination of problems arising in beekeeping, and finally, the fifth topic covered the analysis of future challenges. In addition to the segmenting variables, the main

aspects of the correlation analyses were geographical location (county), farm size, transhumance and specific yields.

The data were processed and evaluated using IBM SPSS 22.0 statistical software and Microsoft 365 Excel. As a first step, I analysed the data by examining the frequency of each factor and performing descriptive statistical analysis, such as minimum, maximum, median, mean and standard deviation.

To test the independence of frequencies between groups, I used Pearson's chi-square (χ^2) test. The chi-square test indicated whether there was a relationship between the categories of two groups and whether the expected frequencies in each category differed from the random level. The empirical value of the chi-square can be compared to a theoretical value, which can be calculated considering the degrees of freedom and the chosen significance level. If the theoretical value of χ^2 is greater than the empirical value of χ^2 , then the difference between the two distributions is small, i.e. the observed correlation does not differ significantly from independence, so we retain the null hypothesis. If the theoretical value of χ^2 is less than the empirical value of χ^2 , then the difference between the two distributions is large, i.e. the null hypothesis is rejected, which means that in this case there is a significant correlation between the variables (HUNYADI and VITA, 2005).

For the distribution analysis of the individual honey yields (variables), I performed a one-sample Kolmogorov-Smirnov test, which confirmed that the variables are not normally distributed. Therefore, I used the non-parametric Mann-Whitney U test to test the differences between the means when comparing two groups, and the Kruskal-Wallis test to compare quantitative variables between three or more groups (HUNYADI and VITA, 2005). The significance level was $p=0.05$ in all cases.

Based on the evaluation of good bee health practices by beekeepers, I performed a cluster analysis to identify variables that cause differences between groups. The variables were selected based on previous research, theoretical considerations and the hypothesis tested (SAJTOS and MITEV, 2007). Prior to the cluster analysis, I performed standardisation, transforming the value of each variable into a standard value. The resulting variables are easier to compare with each other because their mean is 0, their standard deviation is 1, and positive values are above the mean, while negative values are below the mean.

2.2. Methodology of sectoral problem analysis

In addition to the literature reviewed, the sectoral problem analysis was based on the previous work of SZÖLLÖSI and NÁBRÁDI (2008), BLASKÓ et al. (2012), MOLNÁR (2020) – expert interviews and the results of a questionnaire survey. The aim of this was to explore and systematise the problems of the Hungarian beekeeping sector at the sectoral and farm level from the perspective of producers, in line with the research questions.

To achieve the research objective, I first developed a paradigm model of beekeeping using the alternative qualitative research method of "Grounded Theory". The analysis revealed factors that have a significant impact on the sector from the beekeepers' perspective, i.e. it provides a better understanding of the problems and challenges perceived by beekeepers at the operational level. Grounded Theory is a research method in which theory develops from empirical data (GLASER and STRAUSS, 1967). The aim is to create a theory, not to prove it (GLASER, 1992). In Grounded Theory, the theoretical framework is created based on the interviewees' responses and the dimensions they reveal. At the same time, to develop a uniform conceptual framework, I also considered the concepts and terms used in the literature (MITEV et al., 2019).

To establish the research question, I conducted pilot interviews with two beekeepers, which helped to clarify the topics. Data collection was carried out using semi-structured interactive interviews between March and April 2024 with 10 beekeepers whose permanent beekeeping sites are in the Northern Great Plain region. The interviewees were selected using the snowball method (MAHBUB et al., 2019), and their distribution by county is shown in *Figure 1*. The region was selected because the Great Plain is one of the most common destinations for migratory beekeeping in Hungary.

All interviews were confidential and were assigned unique codes for the purpose of presenting the results. It is important to note that the sample is not representative of the entire Hungarian beekeeping population. I applied the concepts of credibility, reliability and interpretability to support the integrity of my qualitative data (VELARDI et al., 2021). I selected a small sample for the study to provide rich, relevant information for achieving the research objectives, similar to other qualitative studies that rely on similar sample sizes and methodologies to understand specific phenomena (DOCKÉS and KLING-EVEILLARD, 2006; YAP et al., 2015; MARX, 2017; SENGER et al., 2017; HECKLÉ et al., 2018; VELARDI et al., 2021; VAN ESPEN, 2023).

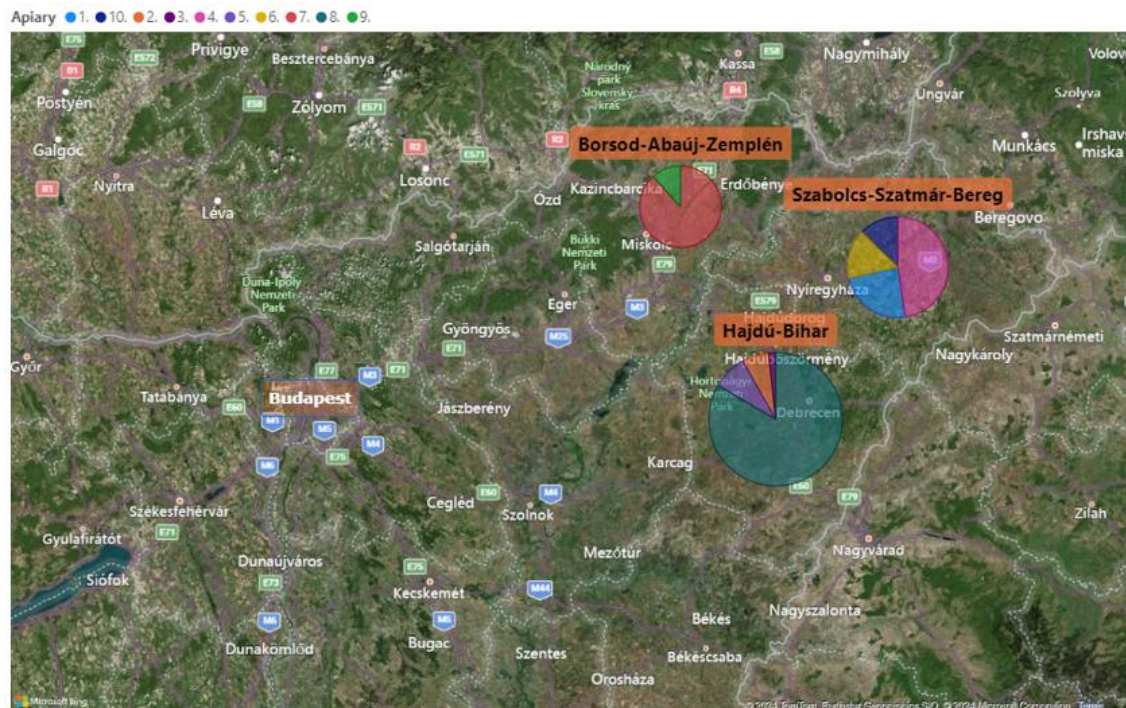


Figure 1: Distribution of beekeepers participating in the interview by number of bee colonies

Source: Own compilation based on own data collection

I analysed the interviews using Atlas.ti content analysis software. During coding, I followed the principles of Grounded Theory (CORBIN and STRAUSS, 1990), i.e. I first created categories using open coding based on the concepts used by the beekeepers, then structured and linked these categories (axial coding). Finally, I identified the most important key categories (selective coding) and outlined the conceptual framework of beekeeping. The essence of the coding process is to determine the relationships between the categories created and summarise them in a model consisting of causal conditions, central phenomena, strategies, context, intervening conditions and consequences (CORBIN and STRAUSS, 1990).

The number of interviews was sufficient to achieve theoretical saturation. When no new relevant information emerges, theoretical saturation is achieved, and the data collection and coding process is completed, followed by the analysis (RÁCZ, 2006). The repetition of the main aspects was clearly observable during the research. I performed a reliability measurement for the coding, which achieved an 85% match in the structure of the subcategories and categories established based on the interviews (MILES and HUBERMAN, 1994).

In the next step, I chose the problem tree analysis method to present the situation and challenges of the sector in a structured way. The problem tree is a universal heuristic for identifying, ranking and visualising problems. It represents the system of causes (factors) and effects (consequences) of a problem. The trunk of the problem tree symbolises the essence of the problem, the roots represent the causes, and the branches represent the effects of the problem (VESELY, 2008). The first step in creating a problem tree is to identify the main problem of the sector, based on which the parts leading to its occurrence can be determined. After exploring the causal relationships between the individual elements, the problem tree can be created by

arranging them into a tree structure. This is a tool that can be used to arrange problems and their causes in a logical order (SZÚCS and NAGY, 2015). In compiling the problem tree, I used the results of literature reviews, questionnaire surveys and expert interviews.

The application of the Grounded Theory method and problem tree analysis methods by other authors in the analysis of the Hungarian beekeeping sector is not known to date.

3. MAIN FINDINGS OF THE THESIS

In Hungary, beekeeping is mainly carried out for income purposes, which is true for both full-time and part-time beekeepers (e.g. alongside work or retirement) as well as hobby beekeepers, although this is mostly true for full-time beekeepers. This is confirmed by the significant differences I found between earning income and types of activity in my research. The most important role of beekeeping, according to both my quantitative and qualitative research, is the production of bee products and pollination by bees. Beekeepers whose families have been involved in beekeeping for several generations tend to regard beekeeping as a hobby and a continuation of a family tradition. Internal motivation depends largely on the purpose of the activity, which is also supported by the context of the beekeeping paradigm model (*Figure 2*). Starting from the central phenomenon, i.e. beekeeping management, the paradigm model encompasses causal, contextual and intervening conditions, strategies, consequences and the relationships between these categories (CORBIN and STRAUSS, 1990).

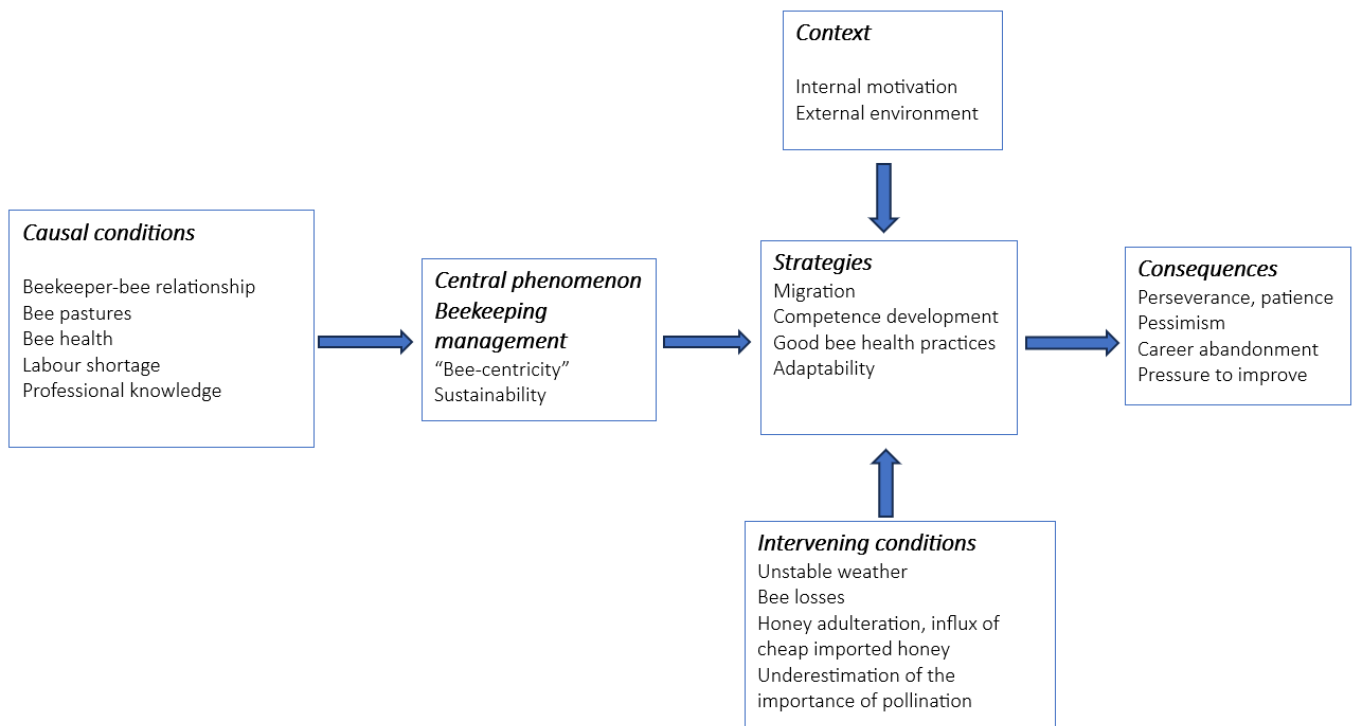


Figure 2: **Paradigm model of beekeeping management**

Source: Own compilation based on own data collection

During my research, I defined four categories of beekeeping farm size, as the number of bee colonies kept by respondents varied widely (between 1 and 1,200 colonies). Accordingly, *hobby beekeeping* is defined as less than 20 bee colonies, *small-scale beekeeping* as between 21 and 100 bee colonies, *semi-professional beekeeping* as between 101 and 150 bee colonies, and *professional beekeeping* as 151 bee colonies or more. Most apiaries fall into the small-scale category.

During my research, I assessed the technological level of apiaries and found that, contrary to what NAGY (2007) had previously stated, technological backwardness is not typical. On the one hand, most apiaries

(67%) use vertical hives instead of the previously widespread large Boczonádi type, and do not plan to change (79.5%), mainly because they are satisfied with the existing system or find the change too costly. However, it should be noted that, according to the survey results, there are also proven technologies for horizontal hives.

Looking at the age of the equipment used by apiaries, I found that hives, honey extractors and honey storage equipment are typically 0-5 and 6-10 years old in small-scale operations, such as hobby and small-scale beekeeping. The mechanisation of honey extraction is also largely resolved, with most beekeepers using 220 V automatic (24%) and semi-automatic (23%) self-turning honey extractors, which indicates an improvement in the efficiency of honey extraction from frames and in terms of working time. The technological characteristics of beekeeping are illustrated in *Figure 3*.

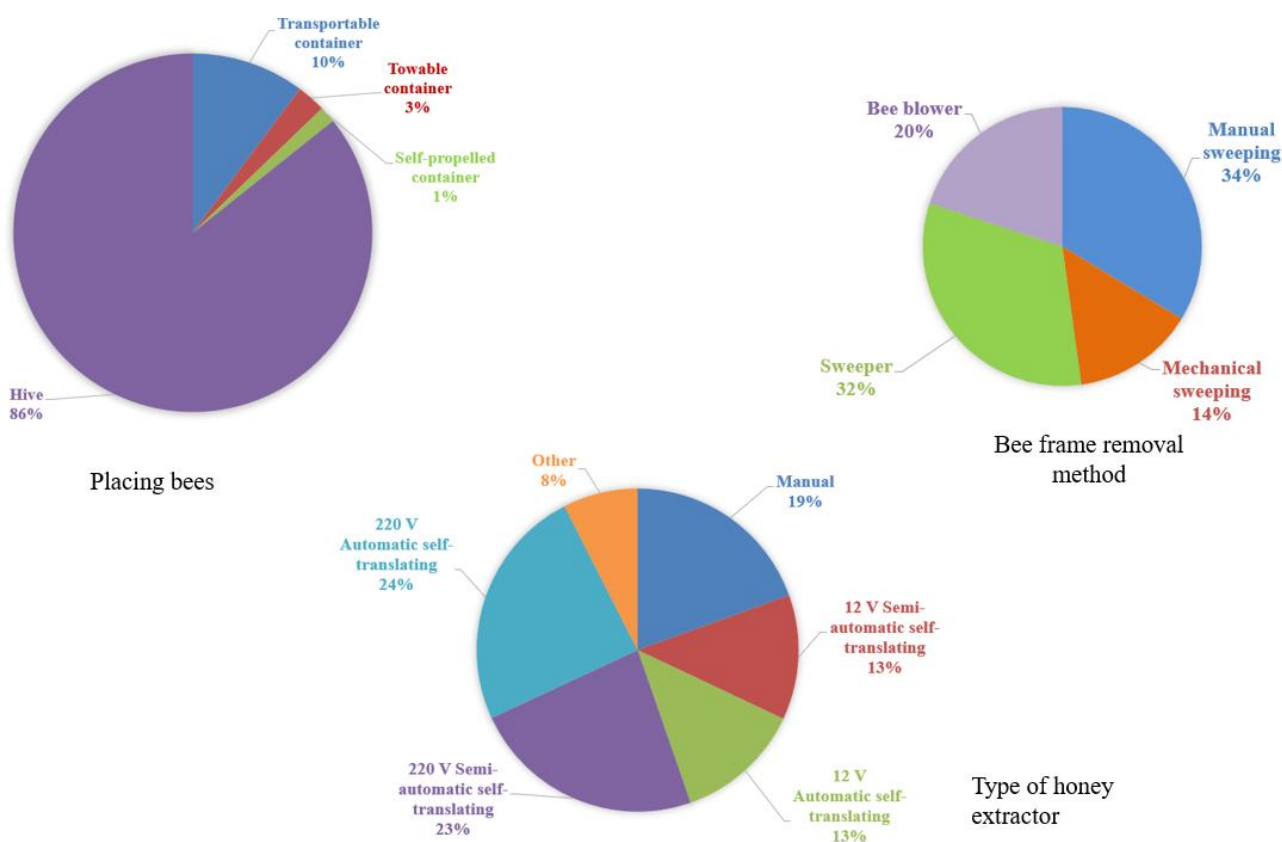


Figure 3: **Characteristics of beekeeping technology**

Source: Own compilation based on own data collection

I found a statistically significant correlation between farm size and the age of hives, frames and honey storage equipment (*Table 1*). The average age of hives is significantly lower on smaller farms ($\chi^2 = 35.134$, $df = 15$, $p = 0.002$). In larger operations, there were fewer new hives than expected, i.e. there were more hives in the 6-10 age group, while those aged 0-5 were less common. Hives older than 21 years are not typical in small operations. Hives aged 16-20 and over 21 were most common in operations with 21-100 hives.

Table 1: Correlation between farm size and age of hives

Age group (years)		Farm size (number of bee colonies)				Total
		<20	21-100	101-150	>151	
0-5	Count	38.0	149.0	41.0	28.0	256.0
	Expected count	22.0	150.6	43.7	39.7	256.0
6-10	Count	21.0	220.0	55.0	70.0	366.0
	Expected count	31.5	215.3	62.5	56.7	366.0
11-15	Count	9.0	89.0	31.0	22.0	151.0
	Expected count	13.0	88.8	25.8	23.4	151.0
16-20	Count	5.0	36.0	19.0	11.0	71.0
	Expected count	6.1	41.8	12.1	11.0	71.0
21-25	Count	0.0	12.0	1.0	4.0	17.0
	Expected count	1.5	10.0	2.9	2.6	17.0
>26	Count	3.0	14.0	4.0	2.0	23.0
	Expected count	2.0	13.5	3.9	3.6	23.0
Sig		0.002				

Source: Own compilation based on own data collection

I found a significant difference in the average age of honey extractors between the different farm sizes ($\chi^2 = 36.994$, $df= 15$, $p= 0.001$) (Table 2). In small-scale beekeeping, honey extractors aged 6-10 years are typically used. In hobby apiaries, the youngest (new or new style) honey extractors are typical.

Table 2: Correlation between farm size and age of honey extractors

Age group (years)		Farm size (number of bee colonies)				Total
		<20	21-100	101-150	>151	
0-5	Count	29.0	186.0	62.0	55.0	332.0
	Expected count	29.0	193.4	56.3	53.3	332.0
6-10	Count	16.0	186.0	51.0	52.0	305.0
	Expected count	26.7	177.7	51.7	49.0	305.0
11-15	Count	9.0	52.0	16.0	200	97.0
	Expected count	8.5	56.5	16.4	15.6	97.0
16-20	Count	7.0	51.0	12.0	11.0	81.0
	Expected count	7.1	47.2	13.7	13.0	81.0
21-25	Count	1.0	13.0	4.0	4.0	22.0
	Expected count	1.9	12.8	37	3.5	22.0
>26	Count	17.0	38.0	80	3.0	66.0
	Expected count	5.8	38.4	11.2	10.6	66.0
Sig		0.001				

Source: Own compilation based on own data collection

The average age of honey storage equipment (e.g. barrels, metal cans) is significantly lower among hobby beekeepers and small-scale beekeepers ($\chi^2 = 27.914$, $df= 15$, $p= 0.022$) (Table 3). The presence of

equipment that is 6-10 years old or older is not typical. In contrast, the use of equipment in the 6-10 age group is typical for professional operations.

Table 3: Correlation between farm size and age of honey storage equipment

Age group (years)		Farm size (number of bee colonies)				Total
		<20	21-100	101-150	>151	
0-5	Count	45.0	236.0	51.0	40.0	372.0
	Expected count	35.1	220.6	58.2	58.2	372.0
6-10	Count	18.0	129.0	42.0	47.0	236.0
	Expected count	22.3	140.0	36.9	36.9	236.0
11-15	Count	2.0	41.0	12.0	13.0	68.0
	Expected count	6.4	40.3	10.6	10.6	68.0
16-20	Count	3.0	30.0	6.0	12.0	51.0
	Expected count	4.8	30.2	8.0	8.0	51.0
21-25	Count	0.0	9.0	3.0	3.0	15.0
	Expected count	1.4	8.9	2.3	2.3	15.0
>26	Count	5.0	14.0	7.0	6.0	32.0
	Expected count	3.0	19.0	5.0	5.0	32.0
Sig		0.022				

Source: Own compilation based on own data collection

- Based on these results, **I reject** my H1 hypothesis (*The main reason for the low level of efficiency in Hungarian honey production is the backwardness of production technology.*).

In Hungarian beekeeping, in line with the size of the available bee pastures, acacia honey, rapeseed honey, and sunflower honey are the main types of honey, with mixed flower honey, linden honey and other types of honey accounting for a smaller proportion. An important indicator of the effectiveness of the activity is the specific honey yield, which, according to my research, is 63.3 kg/bee colony, of which acacia honey accounts for nearly 28 kg/bee colony, sunflower honey 17 kg/colony, and rapeseed honey 7 kg/colony. *Figure 4* shows the distribution of average yields by county. I found that there was only a significant difference between farm sizes in terms of acacia honey, i.e. professional apiaries had the highest specific yield of acacia honey (31 kg/bee colony).



Figure 4: Average honey yield by total honey and main honey types (kg/colony)

Source: Own compilation based on own data collection

Based on my results, I concluded that there is a significant difference in acacia honey yield between farm sizes (K-W, $p=0.000$), i.e. larger apiaries achieve higher yields (Table 4). In the hobby beekeeping category (<20), the specific acacia honey yield is 20.61 kg/bee colony, while in the professional beekeeping category (>151), it is 31.19 kg/bee colony.

Table 4: Correlation between farm size and average honey yields

Farm size (number of bee colonies)		Rapeseed honey	Acacia honey	Sunflower Honey	Linden honey	Other type	Mixed flower honey
<20	Average	8.4	20.61	11.7	7.67	3.33	14.27
	N	10	22	10	6	3	13
	Std. deviation	7.23	16.62	7.334	6.947	5.774	14.723
21-100	Average	10.27	23.79	18.84	8.19	9.3	10.65
	N	145	198	160	58	46	79
	Std. deviation	6.574	11.846	11.437	8.709	13.936	9.208
101-150	Average	9.61	25.59	18.58	8.53	8.44	7.4
	N	46	56	53	17	18	20
	Std. deviation	6.365	9.917	13.038	11.22	7.793	7.119
>151	Average	11.48	31.19	20.71	7.91	6.27	10.47
	N	52	62	51	22	15	17
	Std. deviation	8.449	15.221	11.924	8.423	7.206	8.471

Source: Own compilation based on own data collection

Good bee health practices are becoming an increasingly important factor due to the critical bee health situation. To assess this and examine the measures actually taken to promote it, I conducted a cluster

analysis, in which I formed two groups based on the application of these practices: 'passive observers' (who consider the continuation of the given good practice to be less important) and 'active carers' (who consider it clearly important). There is no statistically significant difference between the two groups in terms of yield. In my opinion, the proper application of good bee health practices has a direct impact on the health, vitality and productivity of bees. This is supported by the content of good bee health practices defined in the strategic elements of the paradigm model.

In relation to farm size, it has been proven that full-time beekeepers have the largest number of bee colonies (K-W, $p=0.000$), with an average of 174 colonies per farm, and 73% of them have more than 10 years of professional experience. At the same time, low numbers of bee colonies are statistically proven to be characteristic of first-generation beekeepers, who have no family members with previous experience in beekeeping.

- Based on these results, **I reject** my hypothesis H2 (*The average honey yield increases in proportion to the farm size.*), as it was only confirmed for acacia honey.

One of the key issues in beekeeping is transhumance practice, which aims to ensure a natural food source for bees and increase honey yield. However, this involves significant costs, as confirmed by the transhumance category defined in the paradigm model strategies. According to the results of my research, transhumance is most intensive in the eastern part of Hungary, where apiaries transport an average of three times and an average of 89 bee colonies to each apiary per beekeeping season. The number of migrated bee colonies is highest in professional operations and lowest among hobby beekeepers, where the aim of the activity is not exclusively to increase honey yield. Small-scale apiaries migrate their colonies in the highest proportion. The most common destinations are the bee pastures of the northern and eastern counties of Hungary, and most kilometres travelled are for acacia (north, east, south), followed by sunflower and, to a lesser extent, rapeseed (*Figure 5*).

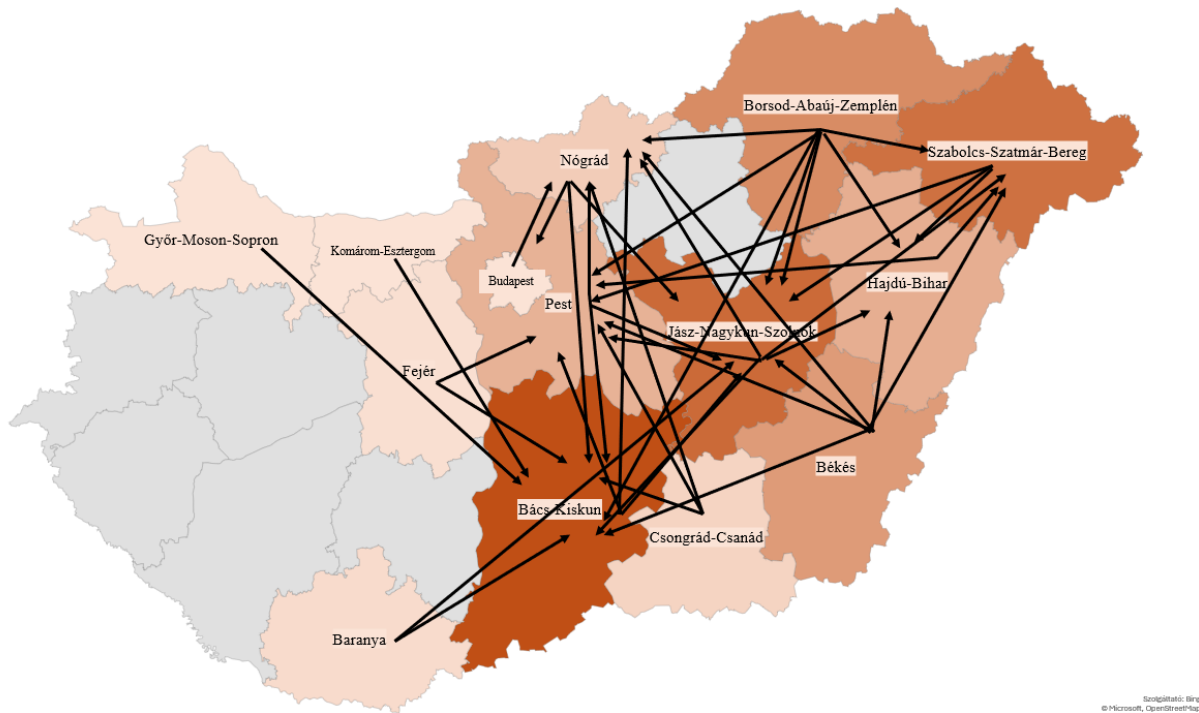


Figure 5: **Most common destinations for transhumance by county in Hungary**

Source: Own compilation based on own data collection

The vehicles used for transhumance are mainly passenger cars (with trailers) and small trucks (up to 3.5 tonnes total weight), which are primarily owned by small-scale and semi-professional beekeepers. It is common practice for beekeepers to compensate landowners for allowing them to relocate their hives. This compensation usually takes the form of gifts of acacia, sunflower and rapeseed honey, amounting to more than 15 kg per beekeeping season. This type of 'bee pasture fee' is most common among small-scale and professional beekeepers.

I also examined the relationship between transhumance and other variables, which I will detail below. Based on this, I found a correlation between the type of hive used and the use of vertical hives (K-W, $p < 0.001$) i.e. in the case of bee transhumance, the average yield of apiaries using vertical hive is approximately 32% higher (27.68 kg/bee colony) than the average yield of apiaries with stationary vertical hive (20.98 kg/bee colony). In the case of horizontal hives, this correlation cannot be statistically verified (Table 5).

Table 5: **Correlation between hive type and transhumance (n=626)**

Hive type	Average yield transhumance (kg/colony)	Average yield without transhumance (kg/bee colony)
Horizontal	26.85	23.13
Vertical	27.68	20.98

Source: Own compilation based on own data collection

About bee transhumance and honey yield, I examined whether there was a difference in the specific yield of the six main honey types depending on whether beekeepers migrated or not (*Table 6*). There is a significant difference (M-W, $p = 0.05$) between the specific yield of acacia honey and sunflower honey and transhumance. In apiaries where bee colonies are migrated, higher yields were achieved for acacia honey and sunflower honey. In terms of these honey types, transhumance resulted in significantly higher specific yields (+26% and +62%) for acacia and sunflower honey than in stationary apiaries. Both bee pastures cover large areas, so transhumance by beekeepers is more intensive. Furthermore, in the case of mixed flower honey, the difference is significant ($p = 0.051$), with lower yields (-61%) in the case of transhumance beekeeping. This is because beekeepers do not remove mixed honey from the hives, so that it remains in the hives as natural food for the bee colonies, thus reducing unnecessary feeding and honey production costs.

Table 6: Correlation between honey yield and transhumance

Do you migrate your bee colonies?		No	Average	Std. deviation	Sig
Rapeseed honey	Yes	179	10.97	9.494	0.862
	No	77	11.65	13,068	
Acacia honey	Yes	225	31.2	59.825	<0.001
	No	117	24.71	23.027	
Sunflower honey	Yes	20	25.14	63.308	<0.001
	No	77	15	13.803	
Linden honey	Yes	6	8.85	9.032	0.338
	No	38	7.13	8.615	
Other varieties	Yes	5	8	8.25	0
	No	27	9	16,558	
Mixed flower honey	Yes	79	9.86	9.676	0.05
	No	53	25.34	54.465	

Source: Own compilation based on own data collection

Beekeepers with more than 5 years of professional experience and relevant qualifications are more likely to take advantage of the possibility of transhumance, which reflects the importance of the expertise required for this activity. The results of my qualitative research show that expertise, i.e. professional knowledge and the development of the beekeeper's own competences, appear on the one hand as a causal condition, i.e. a factor whose presence or absence influences the central phenomenon, i.e. beekeeping itself. On the other hand, one element of the strategy is competence development, i.e. expanding the beekeeper's existing knowledge and skills.

- Based on these results, **I accept** my hypotheses H3 (*There is a positive correlation between professional knowledge and average honey yield*) and H4 (*Higher average honey yields can be achieved with transhumance technology using horizontal and vertical hives*).

The problems affecting beekeepers in Hungary are very diverse, on the one hand, from a bee health perspective, due to difficulties arising during transhumance, conflicts with various parties, problems with honey sales and the negative effects of honey adulteration.

The presence of the Asian honey bee mite (*Varroa destructor*) and the control of *Nosema*, as well as bee mortality caused by pesticides used by agricultural producers, are critical issues in Hungarian beekeeping (Figure 6). Regarding poisoning caused by pesticides, 53% of beekeepers say that they are not consulted at all by landowners or tenants, which is a particular problem in Central, Eastern and Northern Hungary.

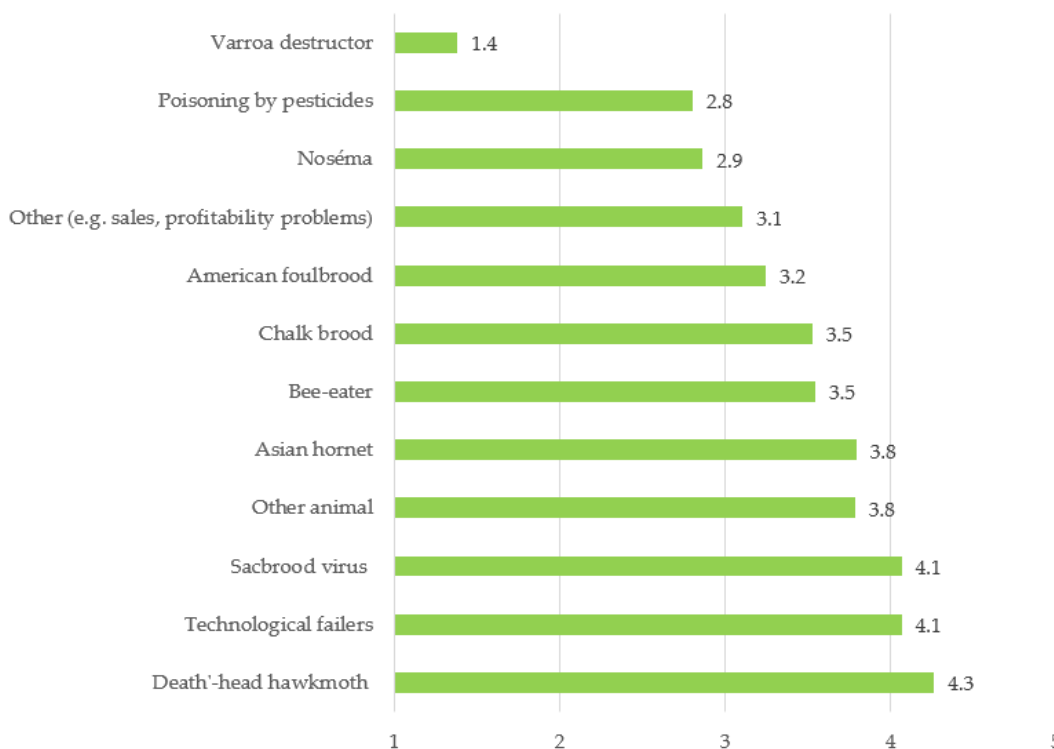


Figure 6: **Ranking of problems encountered in beekeeping (n=632)**

Source: Own compilation based on own data collection

Property protection problems (theft, poisoning) affecting bee colonies were mainly reported in heavily visited counties, such as Bács-Kiskun and Szabolcs-Szatmár-Bereg. My investigations into various conflicts confirmed the correlation with farm size ($\chi^2 = 11.894$, $df = 3$, $p = 0.008$). Semi-professional and professional beekeepers are most likely to come into conflict with agricultural producers and other beekeepers, typically during the transhumance of bees to pastures (Table 7).

Table 7: Correlation between farm size and conflicts

Conflict			Farm size (number of bee colonies)				Total
			<20	21-100	101-150	>151	
Agricultural producer	Yes	Count	3.0	52.0	25.0	30.0	110.0
		Expected count	8.6	63.9	19.4	18.1	110.0
	No	Count	32.0	209.0	54.0	44.0	339.0
		Expected count	26.4	197.1	59.6	55.9	339.0
Sig			<0.001				
With another beekeeper	Yes	Count	4.0	77.0	37.0	37.0	155.0
		Expected count	12.1	90.1	27.3	25.5	155.0
	No	Count	31.0	184.0	42.0	37.0	294.0
		Expected count	22.9	170.9	51.7	48.5	294.0
Sig			<0.001				
Neighbour	Yes	Count	6.0	52.0	23.0	28.0	109.0
		Expected count	8.3	63.5	19.2	18.0	109.0
	No	Count	28.0	209.0	56.0	46.0	339.0
		Expected count	35.7	197.5	59.8	56.0	339.0
Sig			0.008				

Source: Own compilation based on own data collection

In the case of transhumance, I found a statistically significant correlation between the variables only in the case of conflicts with other beekeepers ($\chi^2 = 33.0391$, $df = 1$, $p < 0.001$), which means that conflicts arise in connection with the occupation of territory when migrated bee colonies are placed on different bee pastures. In response to this question, I also examined the correlation with the size of the apiaries. According to my results, there is a statistically significant correlation between the sales problems experienced by beekeepers in the last three years and the size of their operations ($\chi^2 = 24.908$, $df = 3$, $p < 0.001$). Sales difficulties affected professional beekeepers the most, and in this case, I obtained results higher than expected. Sales problems were not typical among hobby beekeepers between 2020 and 2022 (Table 8).

Table 8: Correlation between farm size and sales difficulties (n=439)

Sales difficulties		Farm size (number of bee colonies)				Total
		<20	21-100	101-150	>151	
Yes	Count	7.0	157.0	51.0	55.0	270.0
	Expected count	18.5	158.7	48.0	44.9	270.0
No	Count	23.0	101.0	27.0	18.0	169.0
	Expected count	11.5	99.3	30.0	28.1	169.0
Sig		<0.001				

Source: Own compilation based on own data collection

In connection with problems in the honey market, the issue of honey adulteration cannot be ignored. Among the measures to combat honey adulteration as a complex phenomenon, beekeepers indicated stricter controls and traceability of imported honey, i.e. tests to determine whether imported honey complies with Hungarian and EU standards. Beekeepers who keep bees for income purposes indicated the need for this

measure as the most important requirement in significantly higher proportions. In the paradigm model of beekeeping, honey adulteration was defined as a factor restricting activity and affecting competitiveness among the intervening conditions. Based on my results, there is a statistically significant relationship between the responses indicating action against honey adulteration as the most important measure and income generation as a motivating factor ($\chi^2 = 17.174$, $df= 6$, $p=0.009$) (Table 9).

Table 9: Correlation between income generation and measures against honey adulteration

Measure placed in 1st position		generation income		Total
		Yes	No	
“From hive to table”	Count	59.0	30.0	89.0
	Expected count	66.1	22.9	89.0
More effective action	Count	38.0	10.0	48.0
	Expected count	35.6	12.4	48.0
Strict control of imported honey	Count	166.0	34.0	300.0
	Expected count	148.5	51.5	200.0
Quality certificate	Count	6.0	1.0	7.0
	Expected count	5.2	1.8	7.0
Consumer information	Count	12.0	3.0	15.0
	Expected count	11.1	3.9	7.0
Stricter legislation	Count	81.0	20.0	101.0
	Expected count	75.0	26.0	101.0
Sig		0.009		

Source: Own compilation based on own data collection

This means that respondents who consider the main purpose of beekeeping to be generating income from honey sales consider stricter controls on imported honey to be the most important measure, and the traceability of honey sold by Hungarian producers ("from hive to table") to be the least important issue in this regard.

- Based on these results, **I accept** my hypothesis H6 (*Honey adulteration is a factor that significantly limits the competitiveness of the Hungarian beekeeping sector*).

Based on the literature, most Hungarian beekeepers sell their honey in bulk to wholesalers, with a smaller proportion sold directly to consumers. My research found that the two main sales channels continue to be buyers and the short supply chain. Except for linden honey, I found a statistically significant difference between farm sizes and the various forms of sales, i.e. the larger the beekeeper, the less common sales through the short supply chain. Based on the results, I concluded that there is a statistically significant difference between the size of the operation and honey sales through the short supply chain, apart from linden honey (K-W, $p<0.05$) (Table 10). This means that the larger the apiary, the smaller the proportion of honey sold directly to consumers. The reason for this is that Hungarian beekeepers do not have the

capacity to package large quantities of honey; most of them keep bees as a sideline, and, according to decades of practice, most beekeepers sell their honey in barrels to wholesalers.

Table 10: **Relationship between farm size and sales channel**

Honey type	Sales channel	Average ratio by farm size (number of bee colonies) (%)				
		<20	21-100	101-150	>151	Sig
Rapeseed meal	Wholesaler	40.33	79.13	85.90	24.82	0.06
	Short supply chain	61.54	43.33	24.48	14.87	<0.001
Acacia honey	Wholesaler	74.38	78.27	86.91	90.03	0.061
	Short supply chain	79.69	79.62	27.42	17.91	<0.001
Sunflower honey	Wholesaler	82.00	89.40	90.76	90.56	0.511
	Short supply chain	80.00	51.41	22.88	17.08	<0.001
Linden honey	Wholesaler	-	52.97	50.00	57.20	0.973
	Short supply chain	66.00	68.50	58.73	38.40	0.118
Mixed flower honey	Wholesaler	50.00	64.63	70.19	56.84	0.635
	Short supply chain	88.64	65.39	56.37	43.5	0.011

Source: Own compilation based on own data collection

Due to current profitability problems, beekeepers are trying to take advantage of sectoral support, with 95% of them aware of these opportunities. Small-scale and semi-professional beekeepers accounted for the largest share of support applications.

- Based on these results, **I accept** my hypothesis H5 (*As farm size increases, the importance of honey sales through short supply chains decreases*).

The outlook for beekeeping is fundamentally pessimistic from the producers' point of view, and they are trying to adapt to this with various strategies. This is supported by the elements of persistence, waiting and pressure to develop identified in the definition of the consequences category of the paradigm model. I found several significant differences in plans regarding the size of bee colonies. Fifty-four per cent of beekeepers aim to maintain their apiaries, which is typical for those with more than 101 colonies: 20% plan to reduce their bee colonies, mainly due to a decline in profitability. This is particularly true for semi-professional and professional beekeepers and those over 60 years of age, as well as those who believe that the next generation will not continue the business. Of those planning to expand, 39.5% are forced to increase the number of bee colonies to maintain their previous income level, and this is most common among hobby and small-scale beekeepers and those under 60, who are more likely to believe that a generational change is expected in their beekeeping (*Tables 11-14*).

Table 11: Correlation between maintaining bee colony number levels and farm size

Maintaining bee colonies		Farm size (number of bee colonies)				Total
		<20	21-100	101-150	>151	
Yes	Count	36.0	292.0	94.0	92.0	514.0
	Expected count	45.2	300.3	86.1	82.3	514.0
No	Count	47.0	259.0	64.0	59.0	429.0
	Expected count	37.8	250.7	71.9	68.7	429.0
Sig		0.033				

Source: Own compilation based on own data collection

Table 12: Correlation between bee colony number increase and farm size

Bee colonies increase		Farm size (number of bee colonies)				Total
		<20	21-100	101-150	>151	
Yes	Count	45.0	158.0	30.0	21.0	254
	Expected count	22.1	148.6	42.6	40.7	254
No	Count	37.0	393.0	128.0	130.0	688
	Expected count	59.9	402.4	115.4	110.3	688
Sig		<0.001				

Source: Own compilation based on own data collection

Table 13: Correlation between bee colony number reduction and farm size

Bee colony reduction		Farm size (number of bee colonies)				Total
		<20	21-100	101-150	>151	
Yes	Count	5.0	114.0	40.0	41.0	200.0
	Expected count	17.6	116.7	33.7	32.0	200.0
No	Count	78.0	437.0	119.0	110.0	744.0
	Expected count	65.4	434.3	125.3	119.0	744.0
Sig		0.001				

Source: Own compilation based on own data collection

Table 14: Correlation between changes in bee colony number and age

Change in bee colony number			Age of beekeeper (years)			Total
			<30	31-59	>60	
Decrease	Yes	Count	3.0	39.0	37.0	79.0
		Expected count	5.9	49.8	23.3	79.0
	No	Count	31.0	250.0	98.0	379.0
		Expected count	28.1	239.2	111.7	379.0
	Sig			0.001		
Increase	Yes	Count	13.0	85.0	18.0	116.0
		Expected count	8.6	73.2	34.2	116.0
	No	Count	21.0	204.0	117.0	342.0
		Expected count	25.4	215.8	100.8	342.0
	Sig			<0.001		

Source: Own compilation based on own data collection

Beekeepers expect direct state subsidies for pollination carried out by their bees, the amount of which has been determined in terms of honey yield and monetary value. In this case, the average for migratory beekeepers was significantly higher than for stationary beekeepers, so this is fundamentally related to transhumance (M-W, $p=0.004$) (Table 15). In this regard, the current state subsidy is 1,000 HUF per bee colony, which, in my opinion, contributes only marginally to the costs of providing this ecosystem service and covering the costs of transhumance.

Table 15: Assessment of pollination support from the perspective of transhumance

Transhumance	"Beekeepers should receive direct state support for pollination of other producers' crops by their bees."		
	Average	N	Std. deviation
Yes	2.42	306	1.294
No	2.07	177	1.592
Total	2.29	483	1.418
Sig	0.004		

Source: Own compilation based on own data collection

About the activities of the NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION, I consider it important to note that the largest apiaries did not rate the organisation's effectiveness in bee health issues as highly as hobby beekeepers. They were unable to really judge the NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION's marketing activities, but beekeepers rated the association's work in other areas positively. In my opinion, the association should take this into account in the future. I consider three further factors to be important for the future. These are (1) taking decisive action against negligent beekeepers, (2) improving communication with agricultural producers, and (3) the need for compulsory professional training for beekeepers. These factors are closely linked to bee health issues, the protection of

bee populations and, ultimately, the efficiency of honey production. Experienced and qualified beekeepers considered professional training to be the most important factor.

Based on my findings, I concluded that there is a statistically significant difference between the length of professional experience and the importance of communication between the parties (K-W, $p=0.021$) (Table 16). Based on the average responses for each professional experience category (by years), the largest differences were between those with less than 1 year (3.00), those with 1-5 years (2.30) and those with 5-10 years (2.40) of experience. This means that less experienced beekeepers rated the importance of acting against negligent beekeepers more positively than those with 5-10 years of experience.

Table 16: Correlation between professional experience and factors influencing beekeeping

Professional experience (years)		Action against negligent beekeepers	Improvement of communication with agricultural producers	Mandatory professional training
<1	Average	3.00	3.00	0.00
	N	1	2	1
	Std. deviation	0.000	0.000	0.000
1-5	Average	2.30	2.42	1.56
	N	37	36	36
	Std. deviation	1.288	1.025	1.362
5-10	Average	2.40	2.23	0.90
	N	72	71	69
	Std. deviation	1.083	1.301	1.535
>10	Average	2.68	2.63	1.59
	N	320	317	306
	Std. deviation	0.884	1.031	1.622

Source: Own compilation based on own data collection

In the paradigm model of beekeeping, the elements of strategy that are not defined as economic factors include the adaptability of beekeepers (e.g. bee protection, climate change) and competence development as a response to challenges, which are fundamental to the continuation of the activity.

- Based on these results, **I accept** my hypothesis H7 (*Beyond economic factors, the sustainability of the Hungarian beekeeping sector is largely determined by its ability to adapt to the SDG goals, beyond economic factors*).

Based on the literature review, the results of my questionnaire survey and the theoretical model of beekeeping, I compiled a problem tree for the Hungarian beekeeping sector, which presents the current problems and the causal relationships between them (Figure 7). Some of the problems identified in the literature review are still relevant in the Hungarian beekeeping sector, as confirmed by my quantitative and qualitative research. The central problem is the declining competitiveness of the beekeeping sector, which

is causing this already small sector to lose further ground. In connection with this, I have identified the root problems that directly affect the players in the sector, primarily beekeepers as producers:

- 1) labour shortage;
- 2) low level of professional qualifications;
- 3) bee health problems;
- 4) declining profitability;
- 5) lack of a sectoral database;
- 6) lack of sectoral cooperation;
- 7) exposure to international market trends;
- 8) foreign competition for Hungarian honey.

Beekeepers have no influence over some of these problems, and they cannot be solved at the operational level (e.g. the influx of imported honey). However, it should be noted that there are differences in honey production technologies (e.g. hive type, mechanisation, transhumance), which have an impact on production costs and honey yields and can be improved at the operational and producer level. During both the interviews and the questionnaire survey, beekeepers suggested solutions to some of the problems that came up.

The central problem has both social and economic implications. If honey production declines, the decline in the sector's output and thus in the volume of sales will lead to a decline in macroeconomic indicators such as the foreign trade balance, as honey is an important export product. From a social perspective, the central problem may lead to a decline in the number and capacity of apiaries, resulting in an increase in the number of beekeepers leaving the sector and thus increasing unemployment. In addition, the associated decline in the number of bee colonies threatens pollination and biodiversity conservation.

The first problem I identified was the labour shortage, which can be considered a critical factor, primarily in terms of organising transhumance and honey harvesting. One reason for this is that these tasks are seasonal in nature. As a stopgap solution, beekeepers rely on help from family and friends or other beekeepers on a reciprocal basis. However, this problem does not arise for hobby beekeepers with only a few families. Generational change is also not typical, as beekeeping is not attractive to young people due to its low profitability. According to the literature, the beekeeping community is ageing (NAGY, 2007). In my questionnaire survey, nearly 70% of the beekeepers who responded were in the 31-59 age group, with the youngest generation representing the smallest proportion.

The problem of low levels of expertise means that beekeeping does not require a licence or professional qualification, so people who do not have the necessary professional knowledge also take up beekeeping,

posing a risk to the bee health of other beekeepers. There is no adequate sector-specific education or training in this field. Professional lectures organised by beekeeping associations are attended by a relatively small audience. Based on interviews with beekeepers, it would be important to provide training of an appropriate standard, including professional preparation, before starting beekeeping. According to the results of the questionnaire survey, this is considered most important by those with relevant qualifications.

A significant problem for beekeepers is the critical bee health situation, one of the reasons for which is the high winter mortality of bee colonies, which is costly to replace. Following BLETTLER et al. (2022), I have identified four main reasons for this:

- 1) environmental hazards;
- 2) biological hazards;
- 3) nutritional stress;
- 4) and chemical hazards.

Based on my findings, the most significant problems for Hungarian beekeepers are the Asian honey bee mite (*Varroa destructor*) and *Nosema* as biological hazards, bee poisoning caused by pesticides (chemical hazards), the lack of bee pastures providing sufficient quantity and quality of pollen (nutritional stress) and seasonal shifts caused by climate change, resulting in early flowering or late frosts (environmental damage).

In connection with the above, I have identified the problem of beekeeping practices, which primarily involves the continuation of poor or incorrect farming practices. This is due to the use of multiple technologies and their inappropriate application, i.e. due to the different farm sizes and motivations, hobby beekeepers may not have sufficient professional knowledge or may not devote enough time to good bee health practices. This can have a significant impact on the health of bee populations and, consequently, on the efficiency of beekeeping at both farm and sector level.

The most critical problem at present is the decline in the profitability of beekeeping. This is an extremely complex problem, the main cause of which is the decline in purchase prices in recent years, the disruption of purchases, and at the same time, the multiple increase in input prices (e.g. feed, fuel), while development reserves are not typical in the sector. The latter is the main reason for the increase in sector-level production costs.

The influx of cheap imported honey and honey adulteration (e.g. mixing natural honey with poor-quality honey or sugar syrup) also pushes down the purchase price of honey. The traceability and control system for honey placed on the market is not sufficiently effective. The development of purchase prices is an important factor because most Hungarian beekeepers sell their honey in barrels (in bulk). Based on my findings, the larger the apiary, the lower the sales along the short supply chain, due to the lack of capacity of producers to package honey.

An accurate assessment and monitoring of the sector's performance is greatly hampered by the lack of a uniform database covering the product chain that would provide a good overview of the sector's operators

and production. This is because data collection is not carried out in a uniform system and, in my opinion, does not cover several factors (e.g. type of activity, transhumance), due to a lack of professional capacity and financial resources for the periodic collection of data and information. Some data are kept by NATIONAL FOOD CHAIN SAFETY OFFICE (e.g. number of bee colonies), while estimated data on honey production are collected by NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION and average consumer and purchase prices are published by CENTRAL STATISTICAL OFFICE.² Even less information is available on beekeepers who are not members of NATIONAL HUNGARIAN BEEKEEPERS' ASSOCIATION.

The low level of cooperation within the sector (e.g. joint sales, processing or procurement of inputs) is causing a decline in the sector's competitiveness. In 2024, there were four officially recognised producer groups operating in Hungary in the honey sector. There is little willingness to cooperate, mainly due to conflicting interests within the sector and a general lack of trust, which is typical of the Hungarian agricultural sector. Interestingly, this works much better in neighbouring regions, such as Transylvania.

International exposure can be attributed primarily to the export orientation of Hungarian beekeeping. On foreign markets, Hungarian honey must compete with cheaper honey produced under different conditions. However, it should also be noted that most Hungarian honey is exported in barrels, where further processing and packaging take place, adding greater value.

The problem of foreign competition can be traced back to the influx of cheap imports from third countries (e.g. China, Ukraine, Turkey). These honeys are mostly produced in a regulatory environment that is completely different from Hungarian and EU standards and animal welfare and animal health requirements, which represents a further competitive disadvantage for EU and Hungarian beekeepers.

Beekeepers cannot directly influence some of these problems (e.g. honey adulteration, cheap imports, market problems), but there are others that can be influenced and improved at the operational level. These primarily depend on beekeeping practices and the strategies used in beekeeping (e.g. developments that reduce the need for labour, opportunities to reduce production costs, efforts to increase production efficiency), which I have defined in the paradigm model in Chapter 4.2.

Finally, I conclude that the problem is very complex and requires a comprehensive sectoral strategy to address it, without forgetting the resources needed for implementation and any necessary legislative changes, some of which also pose a challenge at the EU level.

² The organisations mentioned provide data to each other.

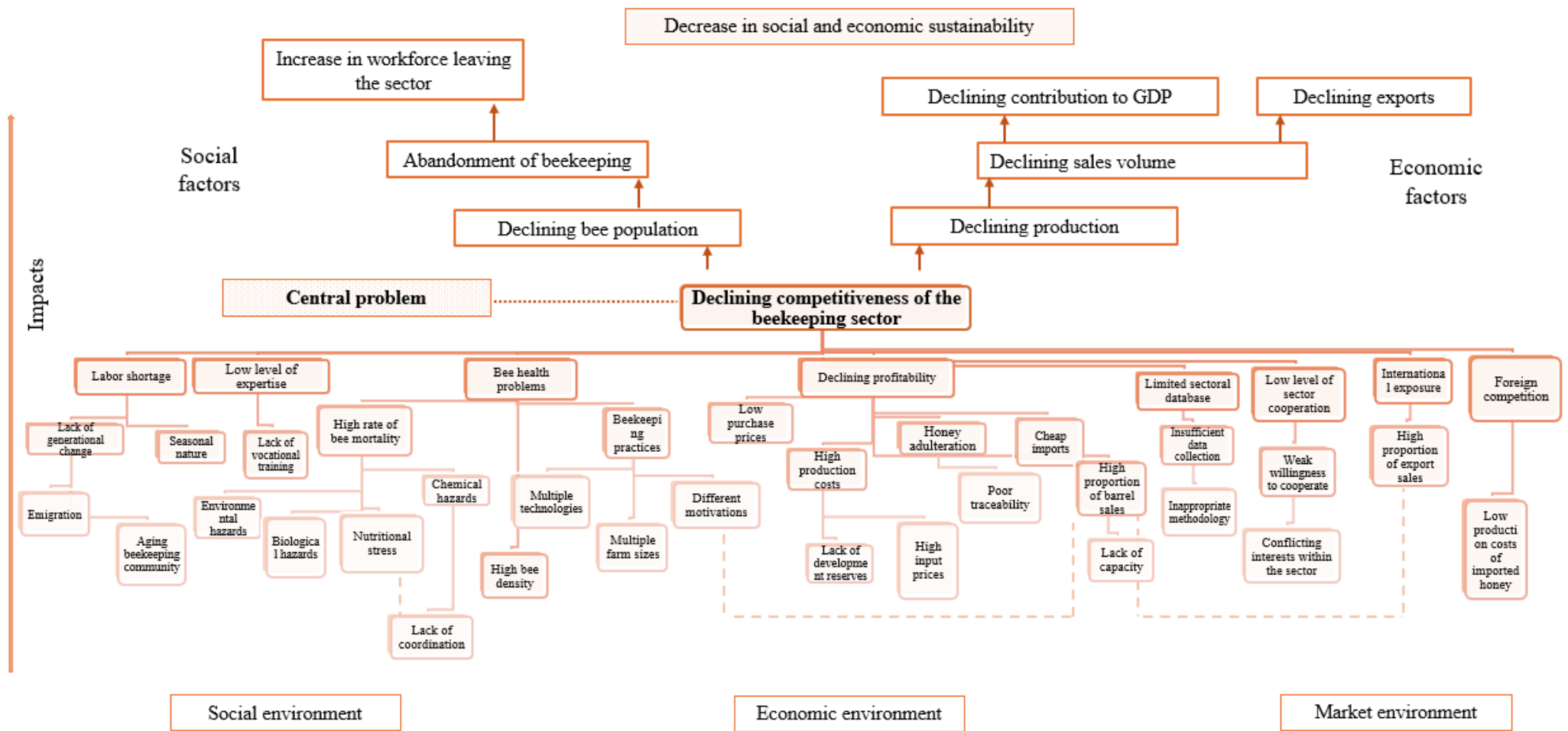


Figure 7: Problem tree of the beekeeping sector in Hungary

Source: Own compilation based on own data collection

4. NEW AND NOVEL RESULTS OF THE THESIS

In achieving the objectives of the thesis, I have identified the following new and novel scientific results:

1. I have verified and quantified that there is a statistically significant correlation between honey yield and the type of hive used, the transhumance of bee colonies and the relevant expertise, as well as between the size of apiaries and transhumance, and the practice of selling honey along the short supply chain.
2. I created a paradigm model for beekeeping management, in which I organised the strategies of beekeeping activities and the factors influencing their implementation into a structured system.
3. With the involvement of industry players, I have factually investigated and confirmed that honey adulteration is a factor that greatly influences the competitiveness of the Hungarian beekeeping sector.
4. During the examination of the situation of the Hungarian beekeeping sector, carried out with the involvement of sectoral actors, I identified and structured its problems, identifying the causal relationships between them (sectoral problem tree) and the specific challenges facing the sector.

5. THE PRACTICAL USE OF THE RESULTS

In my thesis, I examined the current situation of the Hungarian beekeeping sector. The sector is undoubtedly in crisis, which is clear to all stakeholders. The honey market has been struggling since 2022, with low prices, faltering purchases and rising production costs. In my research, I examined these factors from several angles, directly through interviews with beekeepers, i.e. from the perspective of producers. The problems I identified, which include social, economic and political factors, all have an impact on the competitiveness of the sector, and their long-term existence threatens the social and economic sustainability of beekeeping. Based on the research results and the most important challenges facing the sector, I have formulated my own recommendations for improving the situation of the Hungarian beekeeping sector as follows:

Factors causing the decline in the profitability of honey production and the high degree of exposure to international market conditions. Based on my findings from the literature review and my own research, I have summarised the most important challenges facing the sector in the following problem tree:

- 1) Finding solutions to the factors causing the decline in the profitability of honey production and the high degree of exposure to international market conditions, as well as the challenges posed by cheap imports from third countries.
- 2) Problems in the sector, such as bee health, improving honey production and beekeeping practices, improving production conditions, organising the sector's stakeholders, and creating opportunities for further training, require a complex solution strategy and the promotion of vertical and horizontal cooperation.
- 3) In addition to cooperation within the sector, emphasis should be placed on cooperation with agricultural producers whose activities have a direct impact on bee health and beekeeping.

I would like to make the following recommendations to the government, the sector and individual beekeepers with a view to improving the competitiveness of the Hungarian beekeeping sector:

- **At the government level**, I recommend...
 - the creation of a legal framework for the traceability of imported honey and an effective control system for counterfeit honey, as well as the establishment of a system of legal consequences, and the provision of the necessary financial resources to implement the proposals at the sectoral and producer levels.
- **At the sectoral administrative level**, I recommend...
 - the preparation and implementation of a comprehensive sectoral strategy for a period of five years, accompanied by policy monitoring and assistance;
 - the establishment of a complex sectoral data collection system based on an effective methodology;

- the development of an action plan to address environmental, biological, chemical and nutritional threats to bees and, in this context, the extension of the powers of those responsible for bee health;
 - sharing good practices with beekeepers to promote cooperation within the sector, e.g. the operation of recognised beekeeping producer-purchaser-distributor cooperatives currently operating in Hungary, sharing Transylvanian "good practices", etc.;
 - organising and implementing further training for Hungarian beekeepers in a more structured and accessible manner;
 - improving the effectiveness of cooperation between agricultural producers and beekeepers, with particular regard to pollination services and bee protection.
- **At the producer level, I recommend...**
 - maintaining beekeepers' commitment to developing their professional knowledge and skills and complying with the rules of responsible and ethical beekeeping;
 - the design and implementation of an awareness-raising programme aimed at ensuring the valid and comprehensive provision of production and market data and information services.

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7. PUBLICATIONS RELATED TO THE TOPIC OF THE THESIS



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Doctoral School: Doctoral School of Management and Business
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List of publications related to the dissertation

Articles, studies (10)

- Feketéné Ferenczi, A.**, Bauerné Gáthy, A., Szűcs, I., Soltész, A.: The Beekeeping Practice of Transhumance Bee Colonies: Quantitative Study of Honey Production Characteristics Based on a Questionnaire Survey in Hungary.
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10. **Feketéné Ferenczi, A.**, Szűcs, I., Vida, V.: Családi gazdasági keretek között működő méhészeti vállalkozás üzemtani vizsgálata. *Gazdálkodás*. 65 (3), 237-255, 2021. ISSN: 0046-5518.
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List of other publications

Books (1)

11. Szűcs, I., Szöllősi, L., Apáti, F., Madai, H., **Feketéné Ferenczi, A.**, Kurmai, V., Krivdáné Dorogi, D., Marczin, T., Kicska, T.: A főbb hazai mezőgazdasági ágazatok üzemtani elemzése. Debreceni Egyetem Gazdaságtudományi Kar, Debrecen, 155 p., 2022.





Conference presentations (2)

12. **Feketéné Ferenczi, A.**, Bauerné Gáthy, A.: A földhasználat változás hatása a mézelő méh populációra Európában.
In: "Fenntartható Gazdaság - Fenntartható Társadalom" : Nemzetközi Tudományos Konferencia : 30 éves a debreceni közgazdasági és üzleti felsőoktatási képzés = "Sustainable Economy - Sustainable Society" : International Scientific Conference : Celebrating 30 Years of Economics and Business Higher Education in Debrecen. Szerk.: Dajnoki Krisztina, Szenderák János, Erdey László, Fenyves Veronika, Debreceni Egyetem, Debrecen, 57-58, 2024. ISBN: 9789634906247
13. Vida, V., **Feketéné Ferenczi, A.**: Méz fogyasztási és vásárlási szokások a magyar háztartásokban.
In: "Kihívások és tanulságok a menedzsment területén. Fókuszban az Ipar 4.0 kihívásai" programfüzet. Kiadta: Debreceni Egyetem Műszaki Kar, Debreceni Egyetem Műszaki Kar, Debrecen, 18, 2022.

Total IF of journals (all publications): 17,4

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The Candidate's publication data submitted to the Tudóstér have been validated by DEENK on the basis of Web of Science, Scopus and Journal Citation Report (Impact Factor) databases.

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