Identification of the factors affecting the honey production in beekeeping farms of Mersin Province in Turkey

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Abstract

This study aims to evaluate the beekeeping farms in Mersin province economically and to reveal the factors affecting honey production. The questionnaires were carried out in October-November 2020, and the data were collected from 81 beekeepers through face-to-face interviews. The stratified method of sampling was used the number of hives owned to beekeeping farms. Variable, fixed, and total costs of beekeepers in honey production were calculated in the research area. As a result of the determination of honey production cost, it was revealed that 27.38% of the variable cost ratio among the total costs and the variable cost and fixed cost ratio was 72.62%. According to the results, it was seen that the production value was inversely proportional to the increase in size in beekeeping enterprises. It was concluded that the main reason for this difference was that small-scale enterprises used the marketing channel more effectively. The relative profit was calculated as 1.67 $ on average. This result showed that 67% profit could be obtained from spending 1 US$ on honey production in farms. In the study, 14 variables were subjected to factor analysis to determine the factors affecting honey production. As a result of the factor analysis, three groups were defined as production factors, demographic factors, external factors, and the effects of these factor groups on honey production were determined.

Keywords: Beekeeping. Honey. Economic analysis. Profitability. Factor analysis.

1. Introduction

Beekeeping is an agricultural activity that collects, processes honeybee species in specified and regular hives, accommodates them in suitable locations, manages an optimum number of colonies around the year, and harnessing both direct and indirect benefits activities (Sain and Nain, 2017).

Also, beekeeping has several benefits and can occur combined with plants' and animals' different operations without land reliance, requiring less effort and labor. It also offers socio-economic functions by increasing farmers' income level without many lands,

preventing migration from rural to urban areas, and building young people's opportunities in rural areas (Fıratlı et al., 2005; Sarıözkan et al., 2009; Yeninar et al., 2010).

Productivity and income-related factors have a complex structure and are affected by factors like disease and pests, flora, bee genetics, marketing, education, and services of extension in beekeeping (Schouten and John Lloyd, 2019; Schouten, 2020). Determining the factors affecting beekeeping success in developing countries contributes to optimizing investment returns and improving beekeeping activities.

Beekeeping activities can also be carried out for hobby and additional income due to reasons such as requiring less capital and high rate of return, low cost, requiring less labor, and long shelf life of the products obtained. The lack of land is adequate for farmers who do not own land to prefer beekeeping as a source of income.

In 2019, there are approximately 90 million beehives globally, and the amount of honey produced is about 1.9 million tons. Turkey ranks second in China concerning hives and the world's annual production of honey (FAO, 2020). Due to the different climate zones and geography, beekeeping has a vibrant and diverse flora, and Turkey has a traditional agricultural activity carried out in beekeeping in almost every region. There is the potential for production in virtually all provinces of the country.

Beekeeping, as in other countries, Turkey also showing the world's rapid development that provides the natural balance and continuity, and efficiency of agricultural production (Sıralı, 2017). However, the Turkish beekeeping sector has been faced with some technical and economic problems such as low productivity, diseases, excessive and unconscious pesticide usage, inability to allocate accommodation areas effectively, issues in the marketing process, failure to improve its export potential, inadequate cooperation with the beekeeper's union (Emir, 2015).

Mersin Province is one of the most suitable province, primarily for migratory beekeeping in Turkey. However, conventional modes of production continue to dominate the market, impacting production and productivity as a whole (Gürer and Akyol, 2018). Mersin province is ranked 7th in Turkey in terms of 2,270 beekeeping farms. Honey production is equal to 2.15% of the overall output with 2,352 tons and 1.69% of output with 67 tons of wax production (TURKSTAT, 2020).

This study aims to put forth the socio-economic structure in beekeeping, examine the quantity of production of beekeeping products, the costs of the honey production, profitability, and factors influencing honey production. Suggestions to improve the beekeeping sector in the area are provided following the results.

2. Literature Review

There are many studies on the economic assessment of beekeeping. These studies focus on beekeeping production techniques in different regions and countries to solve financial problems (Ören et al., 2010; Vaziritabar and Esmaeilzade, 2016; Sert and Demircan, 2018; Çevrimli and Sakarya, 2019; Nedić et al., 2019; Aydın et al., 2020; Doğan et al., 2020). When previous studies on the subject are examined, the method to determine factors affecting production in beekeeping farms is usually regression analysis (Çevrimli and Sakarya, 2019; Nedić et al., 2019). As in this study, some studies used factor analysis (Nachimuthu and Veni, 2018; Subaşı et al., 2019) to determine honey production factors. Previous studies on beekeeping economics and production factors were outlined below.

Ören et al. (2010) conducted a study in Adana and examined beekeeping activities in the world and Turkey. The study demonstrated the current status of beekeeping activities, socio-economic characteristics of the beekeeping farms, inputs used in beekeeping activities, honey cost, the profitability of beekeeping, productive and effective operating enterprises, and the structure of beekeeping marketing organization were determined. It has been revealed that the cost of honey production and honey sales price varies according to the size of the bee farms, and the transportation and accommodation expenses are also different according to the size of the beekeeping farm.

Vaziritabar and Esmaeilzade (2016) conducted a socio-economic analysis of beekeepers and honey production profitability in Iran's Karaj state. The average annual productivity of the colonies in the study was calculated as 8.64 kg and 3.89 kg for modern and traditional beehives, respectively. Comparing the honey yield performance of different beehive types, they determined the average annual income from beekeeping as US$ 68,845 and revealed that the average annual share of the income from beekeeping varied between 11.24% and 46.09%.

Nachimuthu and Veni (2018) indicated that beekeeping farmers in Ethiopia's Ambara region face many challenges, including climate conditions, flora, diseases, pests, production, storage, and marketing issues. They disclosed the specifications to be applied to enhance beekeeping operations with six variables using factor analysis.

Sert and Demircan (2018) found that the gross production value per hive varied between US$ 254.00 and US$ 271.54 according to beekeeping farm size groups in the study of the beekeeping farms in Isparta, and the lowest and highest production cost per hive was US$ 49.12 and US$ 71.58, respectively. The study determined that as the size of the

beekeeping farm size increased, the production costs per hive decreased, and they found that larger farms had advantages over small farms in terms of production costs per hive. The study determined that permanent labor and feed costs were effective in total production costs, and this ratio was 42.36%, 37.94, and 33.62%, respectively. According to the beekeeping farm groups, the total production cost was 32.01%, 28.51%, etc. They found that 35.71% of them constituted feeding costs.

Çevrimli and Sakarya (2019) conducted an economic analysis of beekeepers in the Aegean Region. The lowest honey production cost (US$ 1.82) is found in large-scale beekeeping farms and Aydın (1.64 US$ kg-^{1}) based on provinces, while the highest production cost (3.14 US$ kg-^{1}) is in small-scale beekeeping farms and Denizli based on provinces (3.79 US$ kg-^{1}) was determined. Net profit per hive is calculated as US$ 41.16, US$ 28.75, and US$ 35.45, respectively, on the scale of beekeeping farms. In the study, they also revealed that the main problem of beekeeping farms in the Aegean Region is marketing; in order to increase the profitability of the enterprises and a sustainable beekeeping activity, the structures of beekeeping cooperatives should be activated in order to increase the retail sales opportunities of the honey produced and to solve the marketing problems.

Nedić et al. (2019) examined the economic indicators of beekeeping farms with different colony sizes in their study in Serbia. In the study, considering the total income and expenses, the threshold of profitability was calculated as 68 colonies or 1.450 kg of honey production, and it was concluded that small-scale farms did not generate enough income to meet variable and fixed costs in the production process and their financial results were negative, while bee farms with large colonies were operated profitably.

Subaşı et al. (2019) conducted an economic analysis of beekeeping farms to identify the factors influencing production in the Mediterranean region. The average relative profit was calculated to be US$ 2.70 per year, and 15 variables were used to explore honey production factors. As a result, special factors, outsourcing, product diversity, and auxiliary variables affect honey production.

Aydın et al. (2020) determined the economic structure and activities of beekeeping farms in the study they conducted in Çanakkale. The study calculated that 34.75% of the production costs consist of variable costs and 65.25% of them are fixed costs, according to the enterprises' average. The study revealed that the cost of 1 kg of honey varies between US$ 2.04 and US$ 3.54, and the average cost of honey is US$ 2.92. The yield per hive belonging to beekeeping farms was 16.24 kg, the production cost per hive was US$ 53.32. The average gross profit was US$ 77.53, the net profit was US$ 42.74, and the relative profit was 1.80.

Doğan et al. (2020) calculated variable costs and gross margin in beekeeping farms in their study in Gümüşhane. The total variable cost per hive was determined as US$ 69.14, and the gross margin was US$ 55.08, and among variable costs, the highest variable costs were determined as labor cost with 38.47%, feeding cost with 31.31% and shipping cost with 10.89%, respectively. The socio-economic factors affecting beekeepers' gross profit were determined as non-beekeeping income, production of bee products other than honey, beekeeping experience, number of hives, and training time.

3. Materials and Methods

3.1. Statistical analysis

Descriptive statistics were used in the data analysis, including mean, standard deviation and percentages, statistics, parametric and nonparametric measurements. The Kolmogorov-Smirnov test calculated the convenience of continuous data. For the normal distribution of continuous data, variance analysis was used. The Kruskal Wallis test was used to determine the variance between the different groups for the non-normally distributed continuous data. A chi-square test was used for categorical variables.

Production costs related to the activity performed are required in the calculation of production costs of beekeeping farms. The production cost is split into fixed and variable costs in two classes. While fixed costs constitute the costs incurred regardless of the production amount, changing prices include the costs that increase or decrease depending on the production amount (Kıral et al., 1999). In this study, as fixed cost items, general administration expenses, family labor fee, bee capital interest, device and machine amortization, device and machine capital interest, and membership fee for the beekeeper's union were taken. As the variable cost items sugar, drug, honeycomb, fuel, transport, jar and tin, costs for accommodation, temporary labor fee, repair and maintenance costs, and circulating capital interest was taken.

In the study, enterprises have taken into account the Male Labor Unit (MLU) while revealing their family workforce (Erkuş and Demirci, 1985). For calculation of the tools' interest expense of 2020, Ziraat Bank's Agricultural Loan Interest Rate (14%) was accessed (ZB, 2020), and half of this rate (%7) multiplied to variable costs. Variable costs were assumed to be distributed homogeneously, and interest costs were calculated for the honey production period. Administrative costs are determined by extracting 3% of the variable

expense (Mulayim, 2008). The number of temporary labor costs determined the cost of family labor. The circulating capital's interest cost was calculated at half of the variable cost based on the Ziraat Bank interest rate on agricultural loans.

Gross Revenue (GR) is the cumulative amount of all the beekeeping farms' outputs as all their products are sold at farm gate rates. This study considered the honey and other bee products, including Royal Jelly, beeswax, pollen, and propolis.

The following formulas were used to measure beekeeper's revenue and profitability (Michael, 2008).

$$GM = \sum_{i=1}^{n} p_i q_i - \sum_{i=1}^{m} c_j x_j$$

where GM is the gross margin of the beekeeping farms, pi is the market unit price of output i, qi is the quantity of output i, cj is the unit cost of the variable input j, xj is the quantity of the variable input j, m is the number of inputs used, and n is the number of outputs produced.

$$NR = TR - TC$$

where NR is net returns, TR is total revenue and, TC is total costs. The values are calculated in Turkish Lira and converted into the average $ exchange rate for 2020.

Factor analysis was used to test the farmers' views on the factors influencing the production of honey. Factor analysis is a quantitative and computational method that can establish the correlation between the variables observed if the change in the number of variables contributes to an increase and reveals their function and interaction. Factor analysis uses statistical approaches to simplify interrelated steps to identify patterns in a variety of variables. The method includes using simulation data in which the answers have already been checked (Child, 2006).

Factor Analysis functions on the notion that real and visible variables, known as minimizing dimensionality, can be reduced to less latent variables with typical variances (Bartholomew et al., 2011). This analysis generally involves variables dependent on common variation in a small number of clusters (Yong and Pearce, 2013).

Tests to justify the use of factor analysis are Bartlett's test and KMO statistics. A high correlation relationship between variables is obtained to estimate the correlation matrix

(Nakip, 2003). As a result of this correlation relationship, the Kaiser-Meyer Olkin (KMO) value is calculated. The KMO value is an index that compares the scale of the observed coefficients. KMO statistics rule that the variable can be used in factor analysis if the value is more significant than 0.50. If the value found in the KMO test is below 0.50 and is not appropriate, 0.60 medium, 0.70 good, 0.80 very good, 0.90 excellent (Field, 2013). The Bartlett Test (Bartlett Test of Sphericity) tests that the data must come from multiple normal distributions (Hair et al. 1998). The number of variables calculated according to the eigenvalue and scree test tables is calculated. In deciding by eigenvalues, variables with an eigenvalue greater than 1 shall be derived. The results were combined with Varimax rotation orthogonal methods.

3.2. Research data

Data from the questionnaires collected from the Mersin Beekeepers Union beekeepers were the study material. Also, local and international studies were used on the subject of research and statistics. The study covers the production period from 2019 to 2020. The data were gathered in November and December 2020.

The Mersin Beekeepers' Union has gathered data concerning the number of hives in beekeeping. In their enterprises, beekeepers with 30 or more hives became members of the union. Data revealed that in 2020 Mersin Beekeepers Union had 1424 registered beekeeping farms. As the coefficient of variance was high, and the stratified random sampling method was determined using the formula below to improve the precision of the results obtained from beekeeping farms and ensure adequate representation of various population sections (Yamane, 1967).

$$n = \frac{\Sigma (N_h S_h)^2}{N^2 D^2 + \Sigma N_h S_h^2}, \qquad D^2 = \frac{e^2}{t^2}$$

where n is the minimum sample size, N the number of beekeepers in the population, N_h the number of beekeepers in a stratum, S_h the standard deviation within a stratum, D^2 the desired variance, e the accepted error from the mean, and t is the t-value corresponding to the accepted confidence interval.

The number of beekeepers was classified into three groups, including 30-100 hives in the first group, 101-180 hives in the second group, and 181 hives and above in the third

group. The number of beekeepers participating in the survey was determined to be 81, with a 10% sampling error margin and 95% confidence (t=1.645). The beekeepers surveyed are proportionally distributed among the strata. The questionnaires were applied in terms of groups, 41, 19, and 21 beekeepers, respectively.

4. Findings and Discussion

The average age of beekeepers was determined at 57.56, with approximately 23.06 years of beekeeping experience. In comparison, beekeepers had an education of 8 years and a family population of about 4 people per farm (Table 1). It was observed that there is a 1% significant difference in terms of farm groups and farmer experiences and education duration, 10% significant difference between the age of beekeepers.

Table 1: Socio-economic profiles of beekeepers

Variables	Beekeeping farm groups			Average
	First group	Second group	Third group	
Age of beekeepers (years)***	60.61±11.00	58.05±9.62	51.14±5.78	57.56±10.26
Experience of beekeepers (years)*	20.98±9.39	25.68±9.09	24.76±6.93	23.06±8.91
Education duration (years)*	7.20±2.82	7.58±3.01	8.90±3.13	7.73±3.00
Household size (person)	3.83±1.50	3.68±1.53	3.76±1.55	3.78±1.50

According to the study in Muğla Province (Çukur and Çukur, 2019), beekeepers' age ranged from 27 to 74 years, and the average age of beekeepers was 48 years. Besides, it is determined that the duration of experience in beekeeping is 26.3 years, the average education period is 5.9 years, and the average family size is 3.6. In another study conducted in Çanakkale (Aktürk and Aydın, 2019), it was determined that the average age of beekeepers was 54.71, the experience period was 19.37 years, the average education period was 9.28 years, and the average family size was 3. In a study conducted in Kenya (Affognon et al., 2015), it was determined that the average age of beekeepers was 51.00, the average experience period was 19.30, the education period was 5.79, and the average family size was 3.82. In a South African study (Ricketts and Shackleton, 2020), the average age of beekeepers in the research area was 45 and family size 7. When evaluated in terms of socio-economic characteristics of beekeeping farms in Mersin province, it is seen that partially older people are engaged in beekeeping. Also, when compared with the other studies examined, it is seen that the beekeepers in the region have sufficient beekeeping experience, and the education level and family size show similar characteristics.

In calculating costs in beekeeping, the costs were analyzed at the level of beekeeping farms as fixed and variable costs. Variable costs increase or decrease according to the usage level of production factors. Due to the usage level of production factors, variable costs increase and decrease. Although fixed costs vary according to production, they are expressed as costs that occur regardless of whether the production is realized or not (İnan, 2016).

Table 2 indicates the cost of beekeeping farms. 27.38% of the average production cost was calculated to be variable costs, and 72.62% to be fixed costs. Although variable costs were found to be higher than fixed costs in many studies (Sert and Demircan, 2018; Özsayın and Karaman, 2018; Subaşı et al., 2019), the study conducted in Iran (Vaziritabar and Esmaeilzade, 2016) calculated the variable cost rate for honey production in modern hives as 18.84% and the variable cost rate for honey production in traditional hives as 32.43%. In a study in Serbia (Nedić et al., 2019), it is seen that the ratio of variable costs in total costs is between 9% and 22%, depending on the size of the colony. In the study in Çanakkale (Aydın et al., 2020), the variable cost rate was 34.75%, and the fixed cost rate was 65.25%. In this study, variable costs were higher in the 3rd group (34.32%) with a high proportional number of hives than other beekeeping farms' groups, which is the lowest in the 1st group (23.31%). Beekeeping farms are considered to be operating more intensively, with a rising variable price ratio. However, the cause of the high-cost variable rate in these farms was not intensive labor but rather an economical size. The highest percentage of variable cost is fuel and transport cost (6.52%) was followed by sugar cost (5.72%) and honeycomb cost (5.63%). When the order of variable cost rates is examined, the results obtained are similar to the studies conducted in Isparta (Sert and Demircan, 2018), in the Mediterranean Region (Subaşı et al., 2019), in Çanakkale (Aydın et al., 2020), and in Gümüşhane (Doğan et al., 2020). In fixed costs, family labor costs were calculated the highest (61.86%) because beekeeping is a labor-intensive production, and beekeeping farms in the research area prefer family labor rather than temporary labor. In the study conducted in the Mediterranean region (Subaşı et al., 2019), and in Çanakkale (Aydın et al., 2020) and in the), this rate has the highest rate (51.24% and 27.32%) among fixed costs.

Table 2: Production costs of beekeeping farms

Cost items	Beekeeping farms groups						Average	
	First group		Second group		Third group			
	US$	%	US$	%	US$	%	US$	%
VARIABLE COST (A)***	15.04	23.31	16.60	30.44	17.86	34.32	16.14	27.38
Sugar costs***	2.77	4.29	3.60	6.61	4.33	8.33	3.37	5.72
Drug cost***	0.98	1.51	1.29	2.36	2.20	4.23	1.37	2.32
Honeycomb cost***	3.13	4.85	3.62	6.63	3.42	6.57	3.32	5.63

Fuel-transport cost***	3.93	6.09	3.71	6.80	3.80	7.30	3.84	6.52
Jar-tin cost***	2.05	3.18	1.67	3.07	1.28	2.46	1.76	2.99
Accommodation cost***	0.43	0.67	0.42	0.77	0.40	0.76	0.42	0.71
Temporary labor***	0.70	1.08	1.46	2.67	1.49	2.87	1.08	1.83
Repair and maintance costs***	0.62	0.96	0.35	0.64	0.42	0.81	0.51	0.86
Circulating capital interest***	0.44	0.68	0.48	0.89	0.52	1.00	0.47	0.80
FIXED COSTS (B)***	49.48	76.69	37.93	69.56	34.18	65.68	42.80	72.62
General administration expenses***	0.45	0.70	0.54	0.99	0.56	1.08	0.50	0.85
Family labor fee***	40.95	63.47	32.96	60.44	30.88	59.34	36.47	61.86
Bee capital interest**	5.40	8.37	2.67	4.90	1.46	2.81	3.74	6.34
Device-machine amortization***	2.21	3.43	1.49	2.73	1.13	2.17	1.76	2.99
Device-machine capital interest***	0.14	0.22	0.09	0.17	0.07	0.13	0.11	0.19
Membership fee	0.33	0.51	0.18	0.33	0.08	0.15	0.23	0.39
TOTAL (C) =(A+B)***	64.52	100.00	54.53	100.00	52.04	100.00	58.94	100.00

*, **, *** significant at 10%, 5% and 1%, respectively.

The average amount of honey produced by hive was determined 9.93 kg on average, and this quantity increased by farm size groups. The honey yield was determined as 12.32 kg hive-1 in the Mediterranean Region (Subaşı et al., 2019), 19.27 kg hive-1 in İzmir (Onuç et al., 2019), and 16.24 kg hive-1 in Çanakkale (Aydın et al., 2020). Although the research area has essential advantages for beekeeping, the most important reason for this low yield is due to bees' deaths due to extreme temperatures at specific periods. The production value derived from honey production was estimated at 80.62 $ farm average (Table 3). Beekeepers were also determined to produce by-products such as royal jelly, beeswax, pollen, and propolis, in addition to the production of honey. However, owing to the low volume of these products, it was determined that farmers tend to use the only beeswax on their farms and earn income by selling other by-products such as Royal Jelly, pollen, and propolis. The results obtained indicate that the rise in the output of other bee products has a positive effect on the farm's income.

The total cost of production honey was calculated at 6.08 US$ kg^{-1}. When the production cost is evaluated in terms of beekeeping farm size groups, the production honey in the first group is 7.23 US$ kg^{-1}, in the second group is 5.41 US$ kg^{-1}, and in the third group is 4.42 US$ kg^{-1}. Based on these observations, the first group's honey cost was estimated to be the highest value.

Gross profit is considered a significant criterion of performance in determining the competitive production level (Aydın et al., 2020). The average farm value and gross profits are 115.88 US$ $hive^{-1}$, and 63.84 US$ $hive^{-1}$, based on the average farm value. The gross profit ratio was estimated at 55.09% for the gross output value. Investment and management incomes are estimated at 37.55 US$ $hive^{-1}$, and the net profit to gross value ratio is calculated as 32.40%. When the net profit values of bee farms are measured according to size groups, the

net profit value has increased since the number of hives has increased. As a result of this increase, bee farms in the third group were able to gain net profit more than farmers in the first and second groups.

Relative profit for beekeepers on expenditure in production activity is recognized as a preferred criterion. In the farms, on average, the average relative profit was calculated at 1.67. This result shows that 67% profit can be obtained from spending 1 US$ on honey production in farms. Concerning farms, the first group's relative profit value was 1.33, for the second group, 1.80 and the third group 2.23. It can be inferred that the beekeepers in the third group make more profit than other beekeeping farm groups, as shown in the results obtained from this study. In this study, it is seen that as the scale of the enterprise increases, the cost of honey production decreases. Similar results were found in Adana (Ören et al., 2010), in Gökçeada (Özsayın and Karaman, 2018), in the Aegean Region (Çevrimli and Sakarya, 2019), in the Mediterranean Region (Subaşı et al., 2019), and in Çanakkale (Aydın et al., 2020).

The Kruskal Wallis test revealed the statistical differences between ($P<0.01$) the groups in terms of honey production amount, honey production value, gross output value, the variable cost, fixed cost, production costs, the production cost of one kg of honey, gross profit, net profit, and relative profit, also statistical differences between ($P<0.05$) the groups in terms of bee products production value (Table 3).

Table 3: Profitability indicators of beekeeping farms

Profitability indicators	First group	Second group	Third group	Average
Honey production amount (kg hive^{-1})***	8.92	10.08	11.78	9.93
Honey production value***	76.44	79.71	89.61	80.62
Bee products production value**	9.43	18.30	26.27	15.88
Gross output value***	85.87	98.01	115.88	96.50
Variable costs (US$ hive^{-1})***	15.04	16.60	17.86	16.14
Fixed costs (US$ hive^{-1})***	49.48	37.93	34.18	42.80
Production costs (US$ hive^{-1})***	64.52	54.53	52.04	58.94
Production cost of 1 kg of honey (US$)***	7.23	5.41	4.42	6.08
Gross profit***	70.83	81.41	98.02	80.36
Net profit***	21.35	43.48	63.84	37.56
Relative profit***	1.33	1.80	2.23	1.67

*, **, *** significant at 10%, 5% and 1%, respectively.

In this study, the factors influencing honey production were identified through Factor analysis. The factor matrix can be interpreted on both vertical and horizontal as a double representation. Each factor is measured separately for vertical analysis, and its dependence is established on each factor. In comparison, the way each attribute relates to evaluating variables is explained for horizontal interpretation. Factors that had eigenvalues above 1 were

used, and the emerging factor numbers were estimated. In this study, 14 variables that can affect honey production are separated into factors through factor analysis. These parameters accounted for 77.617% of the overall variation (Table 4).

The first factor clarified 57.507% of extraction sums of squared loadings and consisting of 9 variables. This factor was referred to as the "production factor." The production factor included the number of hives, the production of honey per hive, the amount of sugar, the amount of fuel, the cost of drugs, the cost of accommodation, the cost of repair and maintenance, the subsidies received to beekeepers, and the amount of honey lost. These factors' average loading is varied between 0.731 and 0.986, calculated 0.907 on average. The second factor clarified 12.146% of the variance and was identified as a "demographic factor". The beekeeper's age, experience in beekeeping, and the male labor unit (MLU) used in beekeeping are the variables that make up this factor. The three variables were calculated to have a mean loading factor of 0.686.

Similarly, in a study conducted in İzmir, it was determined that the beekeeper's professional experience is an essential factor in production (Onuç et al., 2019). The third factor clarified 7.964% of the variance and was referred to as "external factors". The external factors were the number of accommodation places for beekeeping (0.885) and the number of information sources used for beekeeping (0.597). In the factor analysis conducted to reveal the beekeeping practices and problems in Ethiopia's Amhara region (Nachimuthu and Veni, 2018), six variables affecting production were examined. The variance of the variable of the reason for starting beekeeping was determined as 73.169%. In a study conducted in the Mediterranean Region (Subaşı et al., 2019), 15 variables were used, and 4 factors affecting honey production were identified. The measurement level of factor analysis is lower (72.191%) than this study. In the study, 4 factors (specific factors for farms, outsource factor, product variety factor, and auxiliary factors) were obtained, and the production factors included in this study and variables belonging to unique factors for enterprises in the study examined were similar.

In the research, the importance order of the factors affecting honey production was revealed according to Cronbach's alpha value. In this context, the most crucial factor group was the production factor (Cronbach's Alpha=0.836), while the factor with the lowest effect on honey production was the external factor (Cronbach's Alpha=0.506). Based on the results obtained, the variables affecting the production factor should be intervened among the three factors obtained to increase honey production.

Table 4: Analysis of factors affecting honey production

Parameters	Factors			Cronbach's Alpha
	Production factor	Demographic factor	External factors	
Number of hives (item)	0.984	0.016	0.082	
Honey production (kg hive^{-1})	0.969	-0.011	0.079	
Sugar cost ($)	0.942	0.045	0.146	
Fuel amount (ltr)	0.731	0.107	0.219	
Drug cost ($)	0.965	0.045	0.133	0.836
Accommodation cost ($)	0.860	-0.169	0.000	
Repair and maintenance cost ($)	0.955	-0.003	0.082	
Subsidy amount ($)	0.949	0.028	0.083	
Honey loss (kgs)	0.806	0.032	-0.034	
Age of the beekeeper (years)	-0.393	0.581	-0.044	
Experience in beekeeping (years)	0.000	0.875	-0.049	0.546
Male labor unit (MLU)	0.420	0.603	0.239	
Number of accommodation places (item)	-0.047	-0.128	0.885	0.506
Number of information sources (item)	0.321	0.349	0.597	
Eigenvalues	8.051	1.700	1.115	
Variance	57.507	12.146	7.964	
Cumulative Variance	57.507	69.653	77.617	
KMO value		0.918		
Bartlett's Test of Sphericity significance		0.000		

5. Conclusion

Mersin province has a vital position in terms of beekeeping due to its location and climate structure. However, in this study, the average honey yield was 9.93 kg hive-1, which was considerably below Turkey's average (13.55 kg). One of the main reasons for this low productivity is that beekeeping enterprises' production factors cannot be used effectively. When the cost elements in beekeeping enterprises are examined, it is determined that the variable cost ratio is 27.38%, and the fixed costs are 72.62%. Within the scope of the study, it is seen that the most critical factors in honey production cost are family labor fee (61.86%), sugar cost (6.52%), bee capital interest (6.34%), drug cost (5.72%), and fuel cost (5.63%). This situation shows that honey production is affected by the beekeeping farms' expenses rather than the production factors. It has a negative effect on the sustainability of beekeeping activity.

The total production of honey was calculated as 5.94 US$ kg^{-1}. When evaluated in terms of enterprises, it is seen that small-scale beekeepers sell their products at higher prices. Small businesses sell at higher prices depending on the marketing channel they use compared to large enterprises. It is seen that small beekeeping farms sell their products in retail, while large enterprises sell wholesale.

It was determined that the beekeeping farms in the region are trying to increase and diversify their income so that besides honey production, royal jelly, wax, pollen, and propolis are also produced. While beekeepers use the only beeswax among these produced bee products on the farm, almost all other products are sold. However, it is concluded that other bee products are not produced much, although they provide additional income. Thus, beekeeping farms should produce honey and other bee products, which will better bring beekeeping activity.

Although the natural resources in the research area have sufficient advantages in terms of variables such as gross profit and income, beekeeping enterprises continue their activities with low profitability. Low profitability is due to some inadequate management practices and a lack of training. In this context, all official and non-governmental organizations need to identify socio-economic factors, improve beekeeping management, increase profitability, and improve the marketing of bee products other than honey. Organizations should contribute to the development of the sector, especially with training and business management in beekeeping. The study shows that the level of profitability increases in the same direction as the business scale. Therefore, it shows that incentives should be provided for beekeeping to be the primary production instead of continuing as an activity that generates additional income.

In the factor analysis conducted within the study's scope, the most important factor affecting honey production is production. The findings obtained show that the inputs related to production should be used efficiently. Another factor in the study was to come up with the demographic characteristics of beekeepers. While it is observed that beekeeping activities in the region have a sufficient education level and experience in terms of demographic characteristics, it should be ensured that technical knowledge regarding beekeeping should be increased. The third factor obtained, expressed as external factors, reveals the number of accommodation and consultancy variables. For this reason, suitable locations for accommodation allocated for beekeeping to bring honey production to the desired level and consultancy services to increase technical knowledge and experience should be made more widespread.

In this context, a robust support model should be implemented to improve beekeeping activities, focus on studies to increase productivity, increase technology use, disseminate modern beekeeping techniques rather than traditional methods, eliminate accommodation problems, protect and rehabilitate vegetation and diversify bee products. Establishing an effective marketing network will contribute to the solution of many problems. The most critical issue in beekeeping activity is the loss of bees and honey due to beekeeping farms'

diseases. For this reason, studies of public institutions and organizations on this subject are essential for the recognition and treatment of conditions. However, to increase the amount of support given to the hive press and make it more attractive for producers, a new support model should be created for other bee products. Particularly in solving marketing problems becomes more profitable beekeeping, encourage young beekeepers to enter the sector; the growth of farm-scale and the amount of honey production in Turkey will increase the desired level. To solve the marketing problem, making Beekeepers Unions more effective and improving the marketing infrastructure will provide solutions to the issues to a great extent.

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