

# Socio-Economic Determinants on The Profitability of Beekeeping Enterprises in Turkey: A Case Study in The Kelkit District of Gümüşhane

Nilgun DOĞAN<sup>1\*</sup>, Hakan ADANACIOĞLU<sup>2</sup>, Gamze SANER<sup>2</sup>, Cigdem TAKMA<sup>3</sup>

<sup>1</sup> Gumushane University, Aydın Dogan Vocational School, Kelkit Gumushane, TURKEY

<sup>2</sup>Ege University, Faculty of Agriculture, Department of Agricultural Economics, Izmir, TURKEY

<sup>3</sup>Ege University, Faculty of Agriculture, Department of Animal Science, Izmir, TURKEY

\*Corresponding author e-mail: nilgundogan@gumushane.edu.tr

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## ABSTRACT

The aim of this study is to determine the effects of socio-economic factors on the profitability of the beekeeping enterprises in the province of Gümüşhane in Turkey. The relationship between gross profit and some socio-economic characteristics were investigated, and the effects of socio-economic factors on profitability were analyzed by the decision tree method. The results showed that the socio-economic factors affecting the gross profit of beekeepers were the non-beekeeping income, the production of the other bee products except honey, the beekeeping experience, the number of the hives and the years of education. Additionally, if the beekeeping is performed as a second source of income and with more experience, more education and working with fewer beehives will produce positive results on profitability. For producers who did not have any other income, other bee products provided more gross margin per hive. Therefore, other bee products besides the honey production would increase their profitability. The low amount of the other bee products such as propolis, royal jelly, bee pollen, bee bread (perga), apilarnil, bee venom, etc. were result from some socio-economic factors that had been identified in the research area and lack of adequate training. Interventions should aim at trainings that overcome production, management practices and marketing constraints in the value chain.

Keywords: Beekeeping, decision tree, profitability, socio-economic factors, Turkey.

## Introduction

Beekeeping is a branch of production that can be carried out with other agricultural activities in rural areas, and it is also one of the most important agricultural activities

because of the importance of bee products in the human diet, their use in the pharmaceutical, traditional medicine usage in treatment and the role of bees in

improving product quality in crop production.

According to FAO's data on the number of bee colonies, with 9 million 148 thousand colonies, China is in the first place, while the second place is occupied by Turkey with 8 million 331 thousand colonies. China takes part in the first place in the world in terms of the number of colonies with 502 thousand tons in honey production, and it is followed by Turkey (114 thousand tons), the United States (73 thousand tons) and Russia (69 thousand tons) [8]. Although Turkey, both in the number of hives and in the production of honey in the world, comes after China, the value of its exports remains relatively low in comparison to other countries.

Although beekeeping may be practiced almost anywhere around the country, the honey yield per hive is still low in Turkey. According to the 2018 data from Republic of Turkey Ministry of Agriculture and Forestry [21], the yield is only 14 kg per hive in Turkey. Despite the increase in the number of beehives over the years in Turkey, the yield per hive has decreased. The yield per hive decreased from 17 kg in 2005 to 13 kg in 2016 [30]. Productivity is

closely related to the production technique applied in beekeeping. Due to the lack of technical methods, serious financial losses occur in beekeeping. Achieving technical beekeeping increases the economic value of the activity of beekeeping and ensures that it becomes profitable for the beekeeper.

In the world and Turkey, several studies examining the economic aspects of beekeeping have been carried out so far. Beekeeping techniques in various provinces of Turkey have aimed at solving economic problems, and there are many studies about the significance of beekeeping [2, 5, 6, 7, 10, 11, 13, 14, 17, 20, 25, 26, 27, 28-31].

Despite the significance of the beekeeping enterprises, there was no any empirical evidence on potentials and challenges of the beekeeping enterprises in the study area. Republic of Turkey Ministry of Agriculture and Forestry is currently focusing attention on how to increase agricultural production with providing employment opportunities for the local people in rural areas. So, production of the honey and the other bee products in Gümüşhane is important for the national honey market, and this affects a profitable enterprise in this context.

The aim of this study is to determine the effects of socio-economic factors on the profitability of beekeeping farms in the province of Gümüşhane and the relationship between gross profit and some socio-economic characteristics by Decision Tree-CRT algorithm. The socio-economic factors that have an effect on profitability will be identified in this study, and this information will fill the gap in the literature. Furthermore, introducing the optimum type of beekeeping enterprise in Gümüşhane will be a guide for decision-makers and beekeeping enterprises that need such information.

#### *Research questions*

a. What are the socio-economic characteristics of the beekeepers?

b. What are the production characteristics of the beekeeping enterprises?

c. What is the contribution of beekeeping to beekeepers' household income?

d. What is the contribution of beekeeping enterprises to poverty alleviation?

#### *Research hypothesis*

i. There is no significant relationship between selected socio-economic characteristics and poverty status.

ii. There is no significant relationship between beekeeping enterprises' production characteristics and present status

iii. There is no significant relationship between the contribution of beekeeping enterprises and poverty status.

## **Materials and Methods**

The main material of this study was obtained from a survey conducted with beekeeping enterprises. The secondary sources of the study were previous national and international studies and research reports.

Gümüşhane was chosen as the research area where the survey was conducted. There were about 41 thousand hives and

approximately 615 tons of honey production in 2018 [21]. When the number of hives and honey production in the province of Gümüşhane were analyzed based on the district, the Kelkit district had the largest share of production in the province with approximately 17 thousand hives and 441 tons of honey production (Table 1). Therefore, the Kelkit district was included in this study.

Although beekeeping was common in the Kelkit district of Gümüşhane, where the survey was conducted, healthy data on the number of hives could not be obtained. For this reason, it was found appropriate to use proportional sampling method in the study. In addition, the fact that this study was carried out with the own financial resources of the researchers and that there was a time constraint in choosing this method.

The sample size was calculated by using the proportional sampling method. In terms of this method, the sample according to the known or predicted ratio ( $p$ ) of the population size  $N$  is given below [22].

$$n = \frac{Np(1-p)}{(N-1)\sigma_{\hat{p}_x}^2 + p(1-p)}$$

$n$ = Sample size

$N$ = Number of beekeepers in the Kelkit district

$p$ = Proportion of beekeepers on an adequate level (0.50 for maximum sample volume)

$\sigma_{\hat{p}_x}^2$  = Variance of rate

There were 110 registered beekeepers in the Kelkit district in the Bee Registration

System (BRS) of the Ministry of Agriculture and Forestry. Beekeepers in the Beekeepers' Association, producers who were not in BRS, beekeepers with fewer than 30 hives and beekeepers who came to Kelkit from outside (migratory) were also included in the study, and as a result, the population size was calculated as 190 producers. According to the proportional sampling method, the sample size was calculated as 60 with a 90% confidence interval and a 10.5% error rate. The beekeeping enterprises surveyed were selected randomly. In this study, the effects of socio-economic factors on the profitability of the enterprises were analyzed by the decision tree method in this study. The explanatory variables were: the level of education of the producer, age, the beekeeping experience, non-beekeeping income, the size of the producer's household, the type of beekeeping production, bee breeds, number of hives, status, use of consultancy and production of other bee products except honey. Gross profit per hive was used as the dependent (continuous) variable (Table 2).

The gross margin for a beekeeping enterprise is one measure of profitability that is useful for enterprise planning.

Calculation of gross margins may be the starting point for construction of cash flow budgets and assessment of the whole farm's profitability. Gross margin profit is the difference between the annual gross income for that enterprise and the variable costs directly associated with the enterprise [9].

The Classification and Regression Trees (CRT) algorithm is used to construct decision trees. A decision tree is a classification method consisting of decision nodes and leaf nodes in the form of a tree structure. A decision tree algorithm develops a dataset consisting of categorical and/or numerical data by dividing it into

small pieces. In a decision tree, the first node is called the root node, and the other branches are called the decision nodes. A decision node may include one or more branches. According to the contributions of the independent variables in classification of the dependent variable, child nodes are formed. Various algorithms are used to construct the tree. The CRT (Classification and Regression Tree) algorithm is widely used among these algorithms that have been developed. In the CRT algorithm, the contribution of the independent variables to classification of the dependent variable is determined by their importance [3].

## Results and Discussion

### *Socio-Economic Characteristics of Beekeeping Enterprises*

The socio-economic characteristics of the beekeeping enterprises were given in Table 3. The average age of the beekeepers was 52 years, their mean years of education were 8.5 years and the period of beekeeping experience was 19 years. This age result explained that beekeeping was maintained by an older generation and did not attract young people enough in Kelkit area. A similar result on the age factor was obtained

in the beekeeping study of Affognon et al. [1]. The average age of beekeepers was found as 51. Makri et al. [18] found the mean year of education of the beekeepers was 10 years, and the beekeeper age changed from 40 to 50 years. In the study of Öztürk [26], the average period of education of beekeepers were found to be only 5.35 years that was the lower finding from this study.

Approximately 42% of the beekeeping enterprises (25 enterprises) took part in the

animal breeding or the crop production other than the beekeeping, the period of their average agricultural experience was 25 years, and the average period of the beekeeping experience was found as 19 years. This average beekeeping experience value was less than 21 years determined by Ceyhan and Canan [35]. On the other hand, in the study performed by Kalanzi et al. [12], 56.3% of the surveyed beekeepers had less than 10 years of beekeeping experience. In this study, the average household size was found as 4 people. However, in the study that was published by Mbah [19] on the topic of the profitability of honey production, the average size of the households was found as 12 persons.

The average number of hives per farm was 146. The mean sales value obtained from bee products in the production period was calculated as US \$13 930.

The majority of the beekeeping enterprises (66.70%) did not produce other bee products. Only 33.30% of the investigated enterprises produced 1 to 2 other bee products including honey (Table 4). Similar result was obtained in Kebede and Tadesse's [15] study, and the beekeepers

(86.4%) reported that they did not produce any bee products apart from honey.

The interviewed producers (66.70%) stated that they did beekeeping as additional activity. On the other hand in the study by Okpokiri et al. [23], 70% of the beekeepers who participated in the survey reported that they took part in honey production as their main source of livelihood. To the study of Ceyhan and Canan [35]; 64% of Turkish beekeepers do the beekeeping as the main source of income. But this result was obtained different in this study. The main reasons for the beekeeping as a second job by the majority of Kelkit beekeepers were that it was easier to produce in comparison to other production activities (crop and animal), they aimed to provide the employment opportunities for the family members, and it was seen as a profitable activity. When we considered the mean age of the beekeepers in the research area, this finding was an expected result. As a result, it was understood that the training activities could be carried out continuously in order to encourage the beekeeping to the target group of the young or middle age groups.

In order to ensure the economic feasibility of beekeeping, it was necessary to defuse

the missing technical knowledge of the producers about this production activity. In this context, it was important that beekeepers receive basic training in apiculture and seek consultancy from experts during their activities. The findings obtained from this study showed that the level of technical knowledge about beekeeping of the interviewed beekeepers was generally good. As a matter of fact, 83.30% of the beekeepers stated that they participated in a course or a training program on beekeeping in the past. The percentage of the beekeepers receiving consultancy or assistance to obtain technical information on beekeeping was 43.30% at present. However, Kebede and Tadesse [15] showed that the most important problem faced by beekeepers was lack of adequate training on beekeeping.

According to the results, 78.30% of the interviewed producers were members of the Beekeepers Association as it is shown in Table 4. This was a positive result that shows that the producers depended on producer organizations.

#### *Gross Margin Analysis*

The variable costs of the beekeeping enterprises were firstly determined in this

section. The variable costs associated with honey production per colony were given in Table 5.

The total variable costs included subsequently feed costs (sugar and cake), medication (parasite and disease control), wax foundation, transportation of hives, labor, location rental fees, and packaging of honey, repairs and maintenance, interest on variable costs. The total variable cost per hive was determined US\$69.14. Labor cost and feed cost were identified as the significant cost items among the variable costs in this study. In a similar study conducted by Vaziritabar and Esmaeilzade [32] on the profitability of apiculture in the Karaj region of Iran, the variable cost per hive was found as about US\$60.10. Variable costs were obtained as US\$18.53 per hive in the study by Aydın et al. [34] and as US\$94.25 in the study by Adanacioğlu et al. [33]. These results showed that the beekeeping enterprises' operating costs was higher in the study area. According to these results in order to increase the economic performance of the beekeeping enterprises, the feed and the labor cost had to be reduced.

The gross revenue and variable costs associated with honey production are given in Table 6. While the gross revenue per hive was US\$124.22, the total variable costs per hive was calculated as US\$69.14 in the beekeeping enterprises. Therefore, the gross margin was calculated to be US\$55.08 per hive.

#### *Analysis of The Effects of Socio-Economic Factors on The Profitability*

In this section, the effects of socio-economic variables on the gross profit obtained by beekeeping enterprises were shown by the decision tree method. In this context, the effects of the producer's education years, age, beekeeping experience, non-beekeeping income, the size of the producer's household, the type of beekeeping, the bee breed used in production, the number of hives, the type of honey produced, the status of receiving training on beekeeping and the effects of the production of other bee products except honey on the gross profit were analyzed. As a result of the CRT algorithm that was used, the non-beekeeping income of the beekeeper, the beekeeping experience of the producer, the production of other bee products except honey and the number of

hives were found to be more effective than the other factors. Whereas among the evaluated predictors, only two ones "age of enterprise" and "non-beekeeping income" were effective in the study of Aksoy et al. [2].

The non-beekeeping income of the beekeepers was found to be the most effective. The mean gross profit per hive for the producers who had non-beekeeping income was found to be higher (Node 1= US\$58.28 (280.54 TL) than the producers who did not have non-beekeeping income (Node 2= US\$23.92 (115.17 TL). On the other hand, it was seen that beekeeping experience was important for beekeepers with non-beekeeping income.

According to a single beekeeper with less than 1.5 years of experience in beekeeping, the experience variable was subdivided into sub-categories, and the gross profit was found to be lower among the beekeepers with little experience. The gross profit of the producer was found as US\$61.05 (293.86 TL) (Node 4). According to the results of Kutlu [17] on determination of socio-demographic and economic factors that affect honey production, an increase in the beekeeping experience of beekeepers



had a positive effect on honey production. The same finding was reached in the study by Onuç et al. [24]. They found that the professional experience of the beekeeper was an important factor. In our study, in addition to honey, production of other bee products was found to be a significant factor for the producer. The mean gross profit per hive for the producers who produced other bee products was US\$53.99 (259.89 TL) (Node 6), while the mean was US\$ 4.60 (22.14 TL) (Node 5) for the producers who did not.

As another variable, the number of hives was found to be effective on the producers with more beekeeping experience. The gross profit for the producers with less than 98 hives was US\$ 70.59 (339.77 TL) (Node 7), and for those with more than 98, this was US\$ 36.25 (174.50 TL) (Node 8). The years of education was an effective factor for the producers with a low number of hives. The producers with more education years had more gross profit per hive. The gross profit for producers who had more than 5 years of education was US\$ 129.16 (621.67 TL) (Node 10), whereas, for those who had less than 5 years of education, it was US\$ 62.95 (303 TL) (Node 9) (Fig. 1 Tab. 7).

The factors that affected gross profit per hive and their importance values were shown in Table 8 and Fig. 2 (importance and normalized importance values of the independent variables). Among these factors, the non-beekeeping income of the producer was determined as the first and 100% effective factor on gross profit. In a similar study by Aksoy et al. [2], the age indicator was a 100% effective factor. Production of other bee products than honey (79.8%), the producer's beekeeping experience (76.7%), number of hives (75.2%), the producer's education years (69.5%), the producer's age (34.8%), the size of household (18.6%), beekeeping type (15.6%) and honey type (13.6%) followed these. However, the variables on the producer's age, size of household, beekeeping type and honey type were not included in the decision tree diagram

The results showed that the socio-economic factors affecting the gross profit of the beekeeping farms were the income of other bee products except honey, the beekeeping experience of the beekeeper, the number of hives and the education year.

In the regression tree analysis, it was found that the beekeepers who had non-

beekeeping income had more gross profit per hive than the beekeepers who did not. However, it was determined that the beekeepers who had non-beekeeping income, those with fewer hives, and those with high education levels made higher gross profits. The results of this study showed that, if beekeeping was performed as a second job, it was expected that more experience, high education and fewer beehives would have positive results on profitability. In this situation, we might state that, as the activity of beekeeping was carried out as a second job by the majority of beekeeping enterprises, a high number of beehives would limit the effective management of the hives.

## Conclusion

In conclusion, despite having adequate advantages such as the natural resources, the gross profit, and the yield in the research area, the number of beekeeping enterprises are still low. This is due to some insufficient management practices and lack of adequate training. In this context, aiming to improve the beekeeping management and the increasing profitability through identifying the socio-economic factors, providing the

According to the findings, non-beekeeping income beekeepers who produced other bee products than honey had more gross profit per hive. Unfortunately, other bee products than honey were not widely known. There are many products such as propolis, royal jelly, bee pollen, bee bread (perga), apilarnil, and bee venom. All these products may be used effectively in the world in apitherapy and alternative medicine. Without doubt, all the bee products could be used effectively to make more profit by the beekeeping enterprises in the research area. Therefore, production of the other bee products as a side activity to the primary honey production in Gümüşhane would increase the profitability of the beekeeping enterprises.

training courses, improving the marketing bee products except honey will be very vital to all the governmental and non-governmental organizations. Organizations are essential areas of intervention to utilize the management practices and the training.

Beekeeping in Kelkit area should be promoted to improve the employment and as a main income with the young/middle aged local people. Additionally, further

study need to be conducted for improving the technical efficiency of the beekeeping enterprises.

## **Türkiye'de Arıcılık İşletmelerinin Karlılığına İlişkin Sosyo-Ekonomik Belirleyiciler: Gümüşhane'nin Kelkit İlçesinde Uygulamalı Bir Çalışma**

**Öz:** Bu çalışmanın amacı, Gümüşhane ilinde arıcılık işletmelerinin karlılığına etki eden sosyo-ekonomik faktörleri belirlemektir. Brüt kar ile bazı sosyo-ekonomik özellikler arasındaki ilişki araştırılmış ve sosyo-ekonomik faktörlerin karlılık üzerindeki etkileri karar ağacı yöntemi ile analiz edilmiştir. Elde edilen sonuçlar göstermiştir ki, arıcıların brüt kârını etkileyen sosyo-ekonomik faktörler sırasıyla arıcılık dışı gelir, bal hariç diğer arı ürünlerinin üretimi, arıcılık deneyimi,

kovan sayısı ve eğitim yılıdır. Ayrıca, yüksek arıcılık deneyimi, yüksek eğitim seviyesi, az kovan sayısı ve arıcılığın ek gelir olarak yapılması faktörlerinin arıcılık işletmelerinin karlılığını olumlu etkileyeceği saptanmıştır.

Bal hariç propolis, arı sütü, arı poleni, arı ekmeği (perga), apılarnil, arı zehiri,...gibi diğer arı ürünlerinin düşük miktarda üretilmesinin nedeni, araştırma alanında tespit edilen bazı sosyo-ekonomik faktörlerden ve yetersiz eğitim etkinliklerinden kaynaklandığı anlaşılmaktadır. Bundan dolayı, bal üretim değeri zincirinde yapılması gereken müdahaleler; üretim, yönetim uygulamaları ve pazarlama kısıtlamalarının üstesinden gelecek şekilde hedeflenmelidir.

**Anahtar Kelimeler:** Arıcılık, Karlılık, Karar ağacı, Sosyo-ekonomik faktörler, Türkiye

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