Production efficiency of turkish beekeepers and its determinants

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Abstract

The study examined the production efficiency of beekeeping in Turkey. The research data were collected from randomly selected 455 beekeeping businesses by using well-structured questionnaire. Two stage procedure was followed to calculate efficiency scores and explore the efficiency determinants. In first stage, efficiency scores estimated by using data envelopment analysis, while Tobit regression was performed to reveal efficiency determinants. Research results showed that the net income per colony was $140, on average, and the expenditures of per colony was are $61. Research results also showed thatthe mean technical efficiency was 0.84, while that of allocative and economic efficiencies were 0.75 and 0.62, respectively. The main efficiency determinants differed associated with the size of the beekeeping business. In small scale beekeeping business, the age of the beekeepers, management type, mobility and the number of colony affected the efficiency negatively, while credit use and income per colony had positive effect. However, participation the education program, marketing type, the number of colony influenced the efficiency negatively in medium and large scale beekeepers. Focusing on mixed management type and record keeping had the positive effect on efficiency in medium and large scale beekeepers. Orientation of small and medium size beekeepers to sustain beekeeping as a subsidiary sources of income and adopting the large scale beekeepers to mixed management type may increase the production efficiency in Turkey.

Keywords: Beekeeping. Honey Productivity. Production Efficiency. Efficiency Determinants, Turkey.

1. Introduction

Human beings have maintained the honey bee colonies and produced honey together with hive products such as beeswax, propolis, pollen and royal jelly worldwidefor 4500 years. Beekeeping is not only basic income sources but also such kinds of hobby or part time job for rural people all over the world due to less initial and working capital demand and having quick capital recovery. Beekeeping has also the contributions to the not only environmental sustainability and agricultural production via pollination, but also human health. Turkey is one of the main actors in world beekeeping industrydue to having good ecological conditions that ensures the availability of flowers from lots of wildspecies and cultivated plants

throughout the year, even if winter time in Turkey.Turkey ranks second of largest honey producing countries in the world and constituted the 8% of the total world colony and 6% of the world honey production. The contributionof beekeepingindustry is approximately 330 million USD to the Turkish economy. On the other hand, beekeeping has provided employment about 35 thousands of people in rural area (FAO, 2014). In last decades, pressure of increasing domestic and foreign demand to honey and other hive products has made Turkish beekeeping industry transform from small scale production unit to the modern and more commercial economic enterprise. Since the information related economic parameters of beekeeping sector in Turkey is very scarce and fragmented, the economic dimension of the beekeeping enterprises has come into the agenda for stakeholders such as beekeepers' association, many traders and policy makers to develop economy without changing environmental balance. Therefore, efficient use of resources and allocating resources associated with factor prices in beekeeping has become important issue in Turkey, like other main partners acting world bee product market.

Up to now, several researches have been conducted on beekeeping all over the world. However, there has been very limited study to measure technical and economic efficiency due to difficulties to reach healthy and detail management data from beekeepers. Habibullah (1995) analyzed the technical efficiency in Malaysia by using frontier production function. After several years Aburime, et al. (2006) in Nigeria and Abdul-Malik and Mohammed (2012) in Ghana examined the technical efficiency of beekeeping farmers by using stochastic production function. Barlovic et al. (2009) explored the economic efficiency of beekeeping by management type via cost-benefit analysis in Croita. Parallel to the development in world, there have been only two previous studies to measure technical and economic efficiency of beekeeping activities in Turkey. Ören et al. (2010) measured the technical efficiency of beekeepers by using data envelopment analysis. Yıldırım and Ağar (2008) explored the scale effects on technical efficiency of beekeepers by using Cobb-Douglas production function.

The back grounding of the literature showed that it was not clear that the economic performance and efficiency level of beekeepers differs associated with size of beekeepers and management typesall over the world, as well as Turkey. Hence the research intended to test the differentiation of economic performance and efficiency scores of beekeepers by management type and scale considering the ceteris paribus conditions. To reduce the information gap about production efficiency of beekeepers, the purposes of the study were (i)

to measure the efficiency scores, (ii) to reveal efficiency determinants and (iii) to develop strategies and policy to increase efficiency.

2. Production efficiecny

Production efficiency is concerned with the rational use of resources and exploiting the full available potential. It refers to producing goods and services with the optimal combination of inputs to produce maximum output for the minimum cost. The production frontier is mostly used to measure the production efficiecny. The point on the production frontier means that no more production is possible with the given resources and technology without additional costs.

Productive efficiency is closely related to the concept of the allocation efficiency, technical efficiency and scale efficiency. It is recognized from the Farrell (1957) that Technical efficiency (TE) reflects the ability of beekeepers to use minimal input to reach given the level of output, while Allocative Efficiency (AE) reflects the ability of beekeepers to use the inputs in optimal proportions, given their respective prices and the production technology. Then both TE and AE constitute the measure of economic efficiency (EE). (Coelli et al., 2005). Scale efficiency can be used to determine how closely an observed firm is to the most productive scale size and equals to the ratio of the minimum cost of the firm under constant returns-to-scale (CRS) technology to minimum cost under variable returns-to-scale (VRS) technology (Banker et al., 1984).

3. Material and methods

3.1. The Research Area

The Turkey islocated in the coordinatesof 39.1667oN latitudes and 35.6667oE longitudes in Asia. The land area is 783562square kilometers. The populations stand at 77,7 million with 101 people per square kilometers. Turkey has the 806 billion $ nominal GDP and $10492 per capita. Gini coefficienct for income distribution is 0,40. The research was conducted in randomly selected 37 different representative provinces of Turkey, which were Adana, Adıyaman, Ankara, Antalya, Ardahana, Artvin, Aydın, Balıkesir, Bitlis, Bursa, Çanakkale, Diyarbakır, Düzce, Edirne, Erzincan, Erzurum, Hakkari, Hatay, İstanbul, İzmir,

Kahramanmaraş, Kars, Kastamonu, Kırklareli, Konya, Malatya, Mersin, Muğla, Ordu, Rize, Sakarya, Samsun, Siirt, Sivas, Trabzon, Van, Zonguldak. These provinces were illustrated in Figure1.

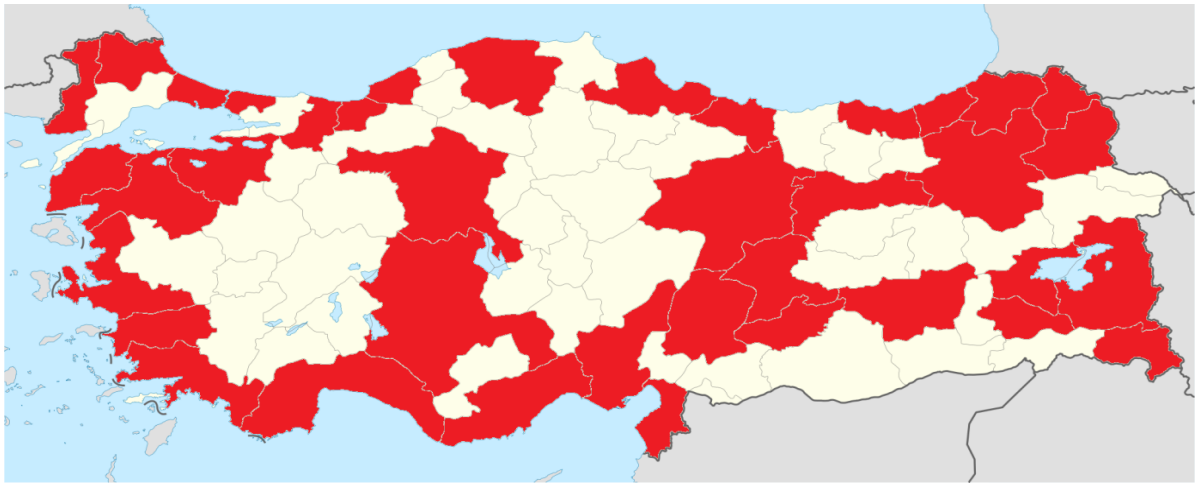

Figure 1: Distribution of the research provinces in Turkey

Turkey is one of the main actors in world beekeeping industry due to having good ecological conditions that ensures the availability of flowers from lots of wildspecies and cultivated plants throughout the year, even if winter time in Turkey. Based on the Turkish Beekeeping statistics, Turkey is the second order following China in the world beekeeping industry, with 6,3 million of colony and approximately 100 thousand tons of honey production. Regarding honey wax production, Turkey is the fourth order. Despite the fast increase in the number of colony in Turkey, unfortunately honey productivity per hive, 18 kg, is below the mean value of the world. Turkey has the 38th order in the world export order, with the export valu $5,2 milion.

Turkey has the approximately 75% of the world flora and 78% of the total flower plants varieties founded in Europe. The main nectar sources were Erica ssp., Eriobatrya japonica L., Prunus amygdalus L., Citrus ssp., Trifolium ssp., Thymus ssp., Astragalus ssp., Salvia officinalis L., Helianthus annuus L., Gossypium ssp., Pinus ssp., Acacia ssp., Tilia ssp., Rhodendron ssp., and Castanea sativa mill.

Kandemir et al., 2000 suggested that there have been five subspecies of an A mellifera in Turkey. Those are A. mellifera carnica, A. mellifera caucaisca, A. mellifera anatoliaca, A. mellifera syriaca, and A. mellifera meda.A. mellifera carnica is distributed from to Austria, Slovakia and Serbia. Carnica honey bees found in Thrace region of Turkey (Kandemir et al.,

2000). Bouga et al. (2011) suggested that A. mellifera anatoliaca habitats across Anatolia from north to south and east to west with locally adapted ecotypes like Muğla, Giresun and Yağlıca. A. mellifera caucaisca can be observed in northeastern Anatolia, near the Georgian border, especially, in Ardahan and Artvin (Kandemir et al., 2000). A. mellifera syriaca is distributed in southeastern Anatolia, Israel, Lebonan, Jordan and Syria. They are the smallest honey bee subspecies in the Middle East. Their nectar collection is very good, but it is hard to manage colonies of these bees owing to their aggresiveness. A. mellifera meda is distributed from eastern Anatolia.

3.2. Typology of the sample beekeepers

Sample farmers were grouped associated with the profession, production sytem and itinerancy. Beekeepers were classified into three different groups such as professional, subsidiary and hobby by profession. If the beekeep ers provided at least 50% of their total income from beekeeping activities and focused on the maximum profit, they would classify as the professional beekeepers. Most professional beekepers in Turkey have been itinerant and their basic occupation has been beekeping. They have focused on the maximum profit and took much more risk compared to other beekepers. Similarly, sample beekeepers would classify as the subsidiary beekeepers if they provided 20% and 50% of their total income from beekeeping activities and assumed the beekeeping as a part time job. These beekeepers have had sufficient income for family needs without beekeeping. As a last group, beekeepers would classify as the hobby, if the beekeepers provided less than 20% of their total income from beekeeping activities and they considered the beekeeping as a hobby rather than commercial activity. On the other hand, we also classified the sample beekeepers into again three different groups such as localized permanent, itinerant intra province and itinerant inter region by itinerancy. If the beekeepers conducted their activities permanently at the place where their record belongs, they would be assigned the localized permanent group. We assigned the beekeepers who were itinerant intra province, if they moved their colony into the border of province that their records belong it to benefit the flowers efficiently and save their colony from winter conditions. Similarly, sample beekeepers were assigned as a itinerant inter region, if they moved their colony inter region and they were wend too much kilometers. According to the production system, we assigned the beekeepers to the specialized beekeepers group, if they produced only focused solely at least the one of hive products such as honey, beeswax,

propolis, pollen and royal jelly. Otherwise, the beekeepers were assigned to the mixed production system group.

Since the homojenity was important when estimating the efficiency scores, sample beekeepers were laso grouped associated with the enterprise size by using cluster analysis in profession, production system and itinerancy groups seperately in order to form homogenous group. Up to now, a physical criterion has been used to group the beekeeperes by several researchers. Saner et al. (2004), Yıldırım and Ağar (2008), Barlovic et al. (2009), Vural and Kahraman (2009), Tijani et al. (2011), Ćejvanović et al. (2011), Pocol et al. (2012) and Kutlu (2014) preferred to use hive number as a grouping criteria when determining the size of beekeeping enterprises. Since the threshold value to determine the beekeepers' groups were not fixed and differed associated with the study or place, there has been no opportunity to attribute the difference among measured variables such as yield, price etc. to size or management type due to non-existing the ceteris paribus conditions. Therefore, the beekeepers take place the same groups have not same characteristics such as colony size, operator's profile, income per hive etc. Following Uzundumlu et al. (2011) used the honey yield per hive as a grouping criterion to increase the quality of grouping the beekeepers. However, the authors ignored the economic characteristics and personal characteristics of beekeepers. That is why, not only physical characteristics but also economic characteristics and personal characteristics of beekeepers were considered when grouping the sample beekeepers by size in the study.

Cluster analysis included the variables of number of hive, return on assets and the profile of beekeepers. Profile of beekeepers was constructed via the index value calculated by using the variables of education level, experience, course participation related to beekeeping, record keeping, beekeepers' union membership and production system. When calculating the profile index for beekeepers, scoring system was used for the variables of education and experience according to the response of sample farmers to the related questions. Scores from 0 to 9 were used to reflects the education level of beekeepers. While we used scores from 1 to 5 for the variable of experience. Course patricipation and beekeepers' union memebership were considered as a total number of course participated by beekeepers in a year and the number of membership, respectively. The variables of record keeping and production system were included the index calculation as a dummy variable. If the beekeepers kept the record, we would take 1, other wise 0. Similarly, we used 1 for specialized beekeepers focused solely at least the one of hive products such as beeswax, propolis, pollen and royal jelly. While the

value for the beekeepers that has mixed production system was 2. Based on the results of the cluster analysis, sample beekeepers were grouped as a small scale enterprise, medium enterprises and large enterprises.

3.3. Data

Research data were collected from randomly selected 455 beekeepers out of 47652active beekeepersrecorded to Turkish Beekeepers Union by using well design questionnaire. Sample beekeepers constituted 77% of the total Turkish beekeepers and their colony was 80% of the total number of colony in Turkey. Random sampling procedure was followed when determining the optimum sample size. The precision and confidence levels were 10% and 99%, respectively during the sampling process. Questionnaires were administered to the sample beekeepers to collect management data by considering the 2012-2013 production years. The variables measured the study were classified into 2broad groups. First, we measured the variables reflects the socio-economic characteristics of beekeepers such as age, experience, schooling, family size, labor, course participation, beekeepers' union membership, record keeping, revenue, cost, solvency, liquidity and credit use. In second, production and marketing characteristics of beekeepers such as number of colony, yields and price of hive products, distance for itinerancy, accommodation, sugar consumption, cake consumption, promotion activities, marketing channel etc.

Table 1 presented the distribution of the sample beekeepers associated with the groups such as profession, production system and itinerancy. The percentage of itinerant inter region and itinerant intra province were 54% and 32%, respectively, while that of localized permanent was 14% in Turkey.

Table 1: The distribution of the sample beekeepers by typology and size

Typology		Size of beekeeper enterprise						Total	
		Small		Medium		Large			
		Frequency	%	Frequency	%	Frequency	%	Frequency	%
Itinerancy	Localized permanent	33	10,9	29	21,0	3	20,0	65	14,3
	Itinerant intraprovince	90	29,8	52	37,7	4	26,7	46	32,1
	Itinerant inter region	179	59,3	57	41,3	8	53,3	244	53,6
	Hobby	15	5,0	9	6,5	2	13,3	26	5,7

Profession	Subsidiary	80	26,5	56	40,6	2	13,3	138	30,3
	Professional	207	68,5	73	52,9	11	73,3	291	64,0
Production system	Specialized	224	74,2	103	74,6	9	60,0	336	73,9
	Mixed	78	25,8	35	25,4	6	40,0	119	26,1
Total		302	66,4	138	30,3	15	3,3	455	100,0

Regarding to profession, 64% of the sample beekeepers were the professional. However, beekeeping was subsidiary income sources for the 30% of the sample beekeepers and hobby for 6% of the sample beekeepers. The share of the beekeeping in total income for hobby purposed beekeepers and subsidiary beekeepers were 17% and 35%, while that of professional beekeepers was 76% ($p<0,01$). On the other hand, 74% of the examined beekeepers were specialized beekeepers while production system was the mixed for the rest.

Large beekeeping enterprises constituted 3% of the sample beekeepers had 145 colonies and their return on family labor and management per colony was $312 in a year, on average. Large size beekeeping enterprises managed by well-educated, experienced, open minded and participatory operators. The share of medium size beekeeping enterprises was 30%. They had 115 colonies and their revenue per colony was $327 in a year, on average. The operator's profile of medium size beekeeping enterprises was relatively unsatisfactory level comparing to large one. Two third of the sample beekeepers were small scale enterprises. They had 208 colonies and their revenue per colony was $89 in a year, on average (Table 2).

Table 2: Some basic characteristics of sample beekeepers by enterprise size

Size	Profile score (unit)	Number of colony (unit)	Return on family labor and management ($/colony)
Small	10, 74 ± 0,16 [b]	208,00 ± 8,00 [a]	89,80 ± 3,86 [c]
Medium	11,65 ± 0,27 [ab]	115,00 ± 7,00 [b]	326,89 ± 8,89 [b]
Large	12,73 ± 0,67 [a]	145,00 ± 33,00 [b]	843,58 ± 62,71 [a]

*The different letter reflects that the difference among the size groups was statistically different at the 5% significance level.

3.4. Efficiency model for beekeepers

The study used the efficiency concept suggested by Farrell (1957), which is the distance between observed input–output combinations and the best-practice frontier. Based on the Farrell approach, maximum output attainable from each input level was assumed as the

best-practice frontier. Since the beekeepers have the more control power over their inputs comparing to their outputs, we constructed the input-orientated efficiency model to measure productive efficiencies. The economic efficiency of beekeeperswas decomposed to the technical efficiency (TE) and allocative efficiency (AE). The Farrell efficiency measures equal 1 for efficient beekeepers, and then decreases with inefficiency (Coelli et al., 2005).

In the study, two-stage approach was used when analyzing the production efficiency of Turkish beekeepers. Efficiency measures such as technical efficiency, allocative efficiency and economic efficiency were estimated in first stage while inefficiency determinants were explored in second stage. When estimating the production efficiencies of homogenous group of beekeepers formed by using cluster analysis, data envelopment analysis was used.

In fist stage, we followed the suggestion of Charnes et al. (1978) and Banker et al. (1984) when constructing the DEA model for beekeepers. In beekeepers level DEA model, we assumed that the value of honey harvested and the value of other hive products (y_i) were outputs, while the number of hive, labor, sugar, transportation cost and accommodation cost were the inputs (x_i). In DEA model, each beekeeper (i) was allowed to set its own set of weights for both inputs and output. The data for all beekeepers are represented by the $K \times N$ input matrix (X) and $M \times N$ output matrix (Y). TE was calculated for the i-the beekeepervia linear programming (LP): $Minimize_{\theta,\lambda}\ \theta$

$$Subject\ to\ -y_i + Y\lambda \geq 0$$

$$\theta x_i - X\lambda \geq 0$$

$$\lambda \geq 0$$

Where θ is the TE score and the vector λ is an $N \times 1$ vector of weights which defines the linear combination of the peers of the i-th beekeeper.

The economic efficiency for the i-th beekeeper can be generated by solving the following LP problem: $Minimize_{\lambda,xi*}\ w_i^T x_i^*$

$$\text{Subject to} \quad -y_i + Y\lambda \geq 0$$

$$x_i^* - X\lambda \geq 0$$

$$\lambda \geq 0,$$

Where w_i is a vector of input prices for the i-th beekeeper; superscript T is the transpose function; x_i^* is the cost-minimizing vector of input quantities for the i-th beekeeper calculated by the LP, given the input prices w_i and output level y_i; and λ is a Nx1 vector of constant. Equation 1 and 2 represents the cost minimization under constant CRS technology. CRS means that output increases in proportion to changes in all inputs. The economic efficiency ($EE_{i,CRS}$) of the i-th beekeeper is calculated as:

$$EE_{i,CRS} = w_i^T x_i^* / w_i^T x_i$$

That is, $EE_{i,CRS}$ is the ratio of the minimum cost to the observed cost, given input prices and CRS technology (Coelli et al., 2005).

Since Turkish beekeepers in the research area conducted their activities under imperfect competition due to imperfect information about market such as input and output prices, and because the size of many beekeepers made them ineligible for institutional loans, we transformed equation (1) to the VRS technology model by adding the convexity constraint: $N1\lambda = 1$, where $N1$ is an $N \times 1$ vector of ones and λ is an Nx1 vector of constant to the equation (1). The allocative efficiency was calculated residually by

$$AE_i = EE_{i,VRS} / TE_i$$

When constructing confidence intervals for the efficiency measures, bootstrapping method, which is procedure to statistical inference based on building a sampling distribution for a statistic by re-sampling from the data, introduced by Efron (1979)was used. First of all, bootstrap samples were explored by means of sampling with replacement from the original random sampling. Following, the bootstrap distribution was derived by calculating statistic for each resample. Finally, 95% bootstrap percentile confidence interval for the efficiency scores were constructed by using the interval between the 2.5th and 97.5th percentiles of the bootstrap distribution.The bootstrapping results were obtained from 120 bootstrap iterations. The standard error of bootstrap was calculated by using formulapresented below (Hesterberg et al., 2003).

$$SE_{boot,\bar{X}} = \sqrt{\frac{1}{B-1}\sum(\bar{x}^* - \frac{1}{B}\sum \bar{x}^*)^2}$$

In the equation, $\bar{x}^*$ is the mean value of an individual re-samples and B is the number of resample.

In second stage of the efficiency analysis, two limit Tobit model was used to reveal the inefficiency determinants.In the inefficiency model, economic efficiency scores was the dependent variable. Since the economic efficiency scores varied from 0,24 to 1, the lower and upper limits of the censored distribution, L_1 and L_2 have been set equal to zero and 1. The independent variables were the age of beekeepers, schooling, course participation, production system, profession, itinerancy, number of colony, record keeping, credit use, return on family labor and management per colony, and marketing style. Since the variables of experience of beekeepers, family members' contribution to beekeeping activities, membership to beekeepers union and having brand were superfluous variable, they removed from the model. The variables of production system, profession and marketing style were included the model as a proxy. For the profession variable, 1 reflected the hobby, while that of subsidiary and professional were 2 and 3, respectively. Localized permanent, itinerant intra province and itinerant inter region beekeepers were assigned 1, 2 and 3, respectively. The last proxy variable, marketing style, 1, 2 and 3 reflected the wholesale, mixed and retail, respectively. Record keeping and production system variables were the dummy variable. If the beekeepers kept management record, we assigned 1, otherwise 0. Similarly, if the production system of beekeepers was mixed, we assigned 1, otherwise 0. The general structure of the two limit Tobit model used the study was depicted below.

$$L_0 = \phi\left[\frac{L_1 - \beta' X_n}{\sigma}\right]^{d_{n0}} \left[\frac{1}{\sigma}\emptyset\left(\frac{y_n - \beta' X_n}{\sigma}\right)\right]^{d_{n1}} \left[1 - \phi\left(\frac{L_2 - \beta' X_n}{\sigma}\right)\right]^{d_{n2}}$$

Where $\Phi$was standard normal cumulative distribution function, $\emptyset$was standard normal probability density function, $\beta$was the vector of regression coefficients, σ was the standard deviation, $X_n$was the matrix of independent variables and $y_n$was the observed value of the normally distributed dependent variable. For each observation, one of the exponents d_{nj} (j=0,1,2) would take a value of one, depending upon whether the value of the observed $y_n$was equal to the lower limit, was in the interval between limits, or was equal to the upper limit, respectively, and all other exponents would take a value of zero. The lower and upper limits of the censored distribution, L_1 and L_2were set equal to zero and one as the data were scaled to take values between those two limits, inclusive.

Assuming an underlying latent variable y_n^* such that:

$$y_n = L_1 \; if \; y_n^* \leq L_1$$

$$y_n = y_n^* \; if \; L_1 < y_n^* < L_2$$

$$y_n = L_2 \, if \; y_n^* \geq L_2$$

The expected value of y_n in the interval between L_1 and L_2 was calculated by following the below expression.

$$\int_{L_1}^{L_2} y \frac{1}{\sigma}\left[\frac{\emptyset\,(y-\beta' X_n)/\sigma}{\phi_{2n}-\phi_{1n}}\right] dy$$

Where ϕ_{2n} and ϕ_{1n} represents the cumulative distribution function of the standard normal, evaluated at $L_1 - \beta' X_n/\sigma$ and $L_2 - \beta' X_n/\sigma$, respectively.

The two limit Tobit regression coefficients were estimated by using package program of LIMDEP 10.0.

3.5. Statistical analysis

In the study, beekeepers'profession, production sytem and itinerancygroups were compared in terms of measured variables after outlining the general situation of Turkish beekeepers by using descriptive statistics such as mean, standard deviation, frequency and percentage. Before beekeepers' groupswere compared by using variance analysis for itinerancy and profession groups and t test for production system group, continuous variables had been tested whether they distributed normally, or not by using Kolmogorov Smirnov test. If the continuous variables were not normally distributed, we performed logarithmic transformation to normalize them.The tests of Mann-Whitney U, Kruskal Wallis and Chi-square were performed to test the differentiation among groups for the discrete variables. The relationship between the continuous variables was explored by using Pearson correlation, while we used Spearman correlation for discrete variables.

4. Research Findings and Discussion

4.1. Socio-economic structure of the Turkish beekeepers

The typical Turkish beekeeper was 49 years old and had 21 year experience on beekeeping. The beekeeper' groups were statistically different in terms of the age and experience of the beekeeper. Itinerant inter region beekeepers was younger than that of itinerant intra province and localized permanent. Similarly, professional and subsidiary beekeepers were younger comparing hobby purposed beekeepers. However, the differences

between specialized and mixed beekeepers and among size groups were statistically insignificant. Regarding the education level of beekeepers, schooling of the typical Turkish beekeeper was 9 years, on average. In Turkey, the schooling years of localized permanent, hobby purposed, mixed and large scale beekeepers were higher comparing to the others. Turkish beekeeper had approximately 1,3 people as a labor force. The differences among the beekeepers' group were statistically significant, apart from the production system group in terms of labor force. Labor of itinerant inter region, mixed and professional beekeeping enterprises was more than the rest. The share of beekeeping revenue in total revenue of beekeeper was 61% in Turkey. The beekeeping share of itinerant inter region, mixed and large scale professional beekeepers gained much more revenue from beekeeping comparing to the others (Table 3).

Table 3: Some social characteristics of sample beekeepers

Typology		Age (year)	Schooling (year)	Experience (year)	Labor(person)	Share of beekeeping revenue (%)
Itinerancy	Localized permanent	51,92± ,59a	10,17±0,54a	20,20±1,62a	1,21±0,02b	41,72±2,60c
	Itinerant intraprovince	51,78±1,00a	9,38±0,38ab	21,6±1,00a	1,22±0,02b	53,70±2,06b
	Itinerant inter region	47,44±0,70b	8,40±0,25b	20,55±0,68a	1,31±0,02a	69,72±1,56a
Profession	Hobby	53,38±2,59a	12,08±0,76a	21,92±2,93a	1,19±0,03b	20,58±1,67c
	Subsidiary	51,35±1,05ab	10,37±0,39b	19,77±1,09a	1,21±0,02ab	35,07±0,79b
	Professional	48,24±0,66b	8,03±0,22c	21,27±0,61a	1,30±0,01a	76,25±1,06a
Production system	Specialized	49,90±0,65a	8,74±0,23b	20,46±0,65b	1,25±0,01b	59,53±1,47b
	Mixed	48,27±1,04a	9,61±0,39a	21,94±0,91a	1,31±0,02a	63,53±2,17a
Size	Small	49,93±0,69a	8,24±0,23c	21,38±0,66a	1,27±0,01a	63,56±1,56ab
	Medium	48,99±0,96a	10,20±0,37b	19,91±0,99a	1,25±0,02a	53,42±1,94b
	Large	44,87±2,87a	12,33±1,01a	18,87±2,06a	1,29±0,06a	66,33±6,28a
Turkey average value		49,47±0,55	8,97±0,20	20,85±0,54	1,26±0,01	60,58±1,23

*The different letter reflects that the difference among the beekeepers' group was statistically different at the 5% significance level.

Based on the economic characteristics of Turkish beekeepers, profitability, liquidity and solvency of beekeepers were satisfactory level in Turkey. Considering return on family labor and management per colony, itinerant inter region, mixed and large scale beekeeping enterprises were better situation comparing to others. However, the case was the reverse when considering operating profit margin ratio. Medium and large size, localized permanent and subsidiary beekeepers were more successful than others in Turkey. Turkish beekeeper had approximately 3 hectares of land. The differences among the beekeepers' group were statistically insignificant, apart from size group in terms of land ownership. Land ownership

of large size beekeeping enterprises was more than the rest. Regarding the liquidity, all sample beekeepers had enough current assets to cover their current debt. The difference among the beekeepers' group was statistically insignificant in terms of liquidity ($p>0.05$). On the other hand, solvency of the itinerant inter region, mixed and small scale beekeeping enterprises were un satisfactory level, resulting in much more credit use (Table 4).

Table 4:.Some economic characteristics of sample beekeepers

Typology		Return on family labor and management per colony ($)	Operating profit margin ratio	Liquidity (current ratio)	Solvency (debt/equity)	Credit use (1000 $)	Land (ha)
Itinerancy	Localized permanent	83,91±10,67a	0,65±0,07a	3,16±0,18a	0,43±0,03b	1,68±0,48c	1,93±0,52a
	Itinerant intraprovince	72,24±5,63b	0,52±0,06a	2,84±0,10ab	0,59±0,02ab	3,25±0,41b	2,60±0,77a
	Itinerant inter region	64,72±4,618c	0,34±0,04b	2,67±0,07b	0,85±0,01a	7,71±0,56a	3,01±1,08a
Profession	Hobby	84,27±21,60a	0,42±0,09b	2,57±0,27a	0,43±0,05b	1,30±0,66c	1,35±0,36a
	Subsidiary	69,43±5,07a	0,67±0,07a	2,89±0,10a	0,61±0,02ab	3,52±0,51b	5,31±2,30a
	Professional	68,79±4,08a	0,33±0,03b	2,74±0,07a	0,82±0,02a	6,69±0,48a	1,62±0,21a
Production system	Specialized	65,16±3,54b	0,44±0,04a	2,67±0,06b	0,72±0,01a	5,01±0,40b	2,85±0,82a
	Mixed	83,16±7,35a	0,44±0,03a	3,06±0,10a	0,67±0,02a	6,56±0,76a	2,36±0,68a
Size	Small	33,63±1,45c	0,29±0,04b	2,49±0,06b	0,79±0,01a	6,10±0,48a	2,56±0,88b
	Medium	122,43±3,33b	0,73±0,03a	3,76±0,09a	0,54±0,02b	3,98±0,50b	2,29±0,35b
	Large	315,95±23,49a	0,83±0,03a	3,48±0,00a	0,41±0,00c	4,92±1,36b	9,91±6,73a
Turkey average value		69,87±3,27	0,44±0,03	2,77±0,05	0,72±0,02	5,42 ± 0,36	2,72±0,63

*The different letter reflects that the difference among the beekeepers' group was statistically different at the 5% significance level.

In Turkey, beekeepers had 126 colonies, on average and itinerant inter region beekeepers were the maximum number of colony.It meant that local permanent beekeeper become itinerant first intra province and following inter region, the number of colonies was also increased. Since the distance was approximately 5 times more than others for itinerant inter region beekeepers, productivity of honey, pollen and propolis of it was higher than that of others. Regarding the profession, the maximum colony was observed in professional beekeepers, while the least number of colonies was in hobby purposed beekeepers. In similar, beekeepers whose production system was mixed had more colonies than that of specialized one.Interestingly, small scale beekeepers conducted their activities with more colonies than that of rest (Table 5).

Table 5: Some production characteristics of sample beekeepers

Typology	Number of colony	Distance (km)	Honey yield per colony (g)	Pollen yield per colony (g)	Propolis yield per colony (g)

Migration	Localized permanent	127±10,74[a]	0,00±0,00c	12,96±1,12b	0,80±0,21a	217,22±87,83a
	Migratory intra province	172±9,10[b]	308,27±31,58b	14,11±0,59b	0,87±0,20a	133,67±84,18a
	Migratory inter region	267±10,51[b]	1476,64±54,65a	23,12±0,80a	1,31±0,17a	40,00±0,00a
Profession	Hobby	132±20,17[a]	292,38±106,29b	14,73±1,34b	0,70±0,18a	0,00±0,00a
	Subsidiary	148±7,05[a]	527,57±60,72b	15,58±0,91b	0,69±0,20a	300,00±0,00a
	Professional	210±8,75[b]	1116,51±55,90a	21,10±0,71a	1,29±0,15a	132,11±55,02a
Production system	Specialized	179±5,97[a]	913,71±51,95a	19,37±0,67a	1,24±0,19a	122,67±88,73a
	Mixed	222±13,45[b]	826,08±74,83b	18,59±0,97a	0,96±0,13b	181,17±71,81a
Size	Small	208±8,00 [a]	1031,71±57,11a	18,91±0,69a	1,13±0,16a	47,00±13,45a
	Medium	115±7,00 [b]	618,58±57,52b	19,42±1,02a	1,10±0,23a	303,33±3,33a
	Large	145±33,00[b]	557,93±171,28b	21,59±2,62a	1,20±0,46a	41,66±0,00a
Turkey average value		126±9,84	890,79±43,06	19,79±0,16	1,13±0,12	156,09 ± 52,32

*The different letter reflects that the difference among the beekeepers' group was statistically different at the 5% significance level.

4.2. Efficiency measures of the Turkish beekeepers

Efficiency analysis showed that the technical efficiency of the Turkish beekeepers varied from 0,47to 1 and it was 0,84, on average. It meant that Turkish beekeepers had the opportunity to reduce their inputs by 16% without output decrease. Estimated technical efficiency scores were statistically different in each beekeepers' group ($p<0,01$). The mean technical efficiency score of localized permanent beekeepers was higher than that of itinerant beekeepers. Similarly, beekeepers conducted their activities as a hobby and subsidiary had the higher technical efficiency scores than professional one. Technical efficiency score of mixed beekeepers was better comparing to specialized one. Increasing enterprise size led to increase in technical efficiency scores of beekeepers in Turkey.Almost half of the Turkish beekeepers had the higher technical efficiency scores than Turkey average. The technical efficiency scores of itinerant inter region, professional and small size beekeepers were lower than the Turkish average value. Third out of the four of sample medium and large scale beekeepers had the higher technical efficiency scores than Turkey average value, while that of small size beekeepers were 40%. 94% of the localized permanent beekeepers had the higher technical efficiency scores than Turkey average. Whereas this percentage was 35% for itinerant inter region beekeepers (Table 6).

Table 6: Efficiency measures of sample beekeepers by migration, production system, profession, and enterprise size

Typology	Efficiency measures		
	Technical	Allocative	Economic
Localized permanent	0,97±0,01a	0,74±0,02a	0,71±0,02a

Migration	Migratory intra province	0,86±0,01b	0,74±0,01a	0,63±0,01b
	Migratory inter region	0,78±0,01c	0,76±0,01a	0,60±0,01b
Profession	Hobby	0,88±0,03a	0,81±0,02a	0,71±0,03a
	Subsidiary	0,89±0,01ab	0,75±0,01b	0,66±0,01a
	Professional	0,81±0,01b	0,74±0,01b	0,60±0,01b
Production system	Specialized	0,82±0,01b	0,75±0,01a	0,61±0,01b
	Mixed	0,87±0,01a	0,75±0,01a	0,65±0,02a
Size	Small	0,79±0,01b	0,72±0,01b	0,57±0,01c
	Medium	0,91±0,01a	0,78±0,01b	0,72±0,01b
	Large	0,94±0,03a	0,87±0,03a	0,81±0,04a
Turkey average value		0,84±0,01	0,75±0,01	0,63±0,01

*The different letter reflects that the difference among the beekeepers' group was statistically different at the 5% significance level.

It was clear that the percentage of taking place the higher point than Turkey average decreased when moving from permanent one to the itinerant inter region ($\chi^2 = 77{,}577, p < 0{,}01$). The case was the similar when moving from subsidiary one to professional ($\chi^2 = 22{,}424, p < 0{,}01$). The percentageof taking the value higher than Turkey average of mixed and specialized beekeepers were 61% and 48%, respectively ($\chi^2 = 6{,}626, p < 0{,}05$).

Based on the scores of allocative efficiency, Turkish beekeepers' input allocation were not relevantinput prices. The mean allocative efficiency score of sample beekeepers ranged from 0,30 to 1 and it was 0.75, on average. Estimated allocative efficiency scores varied associated with size and profession. Allocative efficiencies of beekeepers conducted their activities as hobby was better than that of others. Allocative efficiency scores increased associated with enterprise size. 54% of the sample beekeepers had the larger allocative efficiency scores than Turkish average value, while the rest had lower allocative efficiency scores. With the exception of medium size and hobby pruposed beekeepers, all the mean value of allocative efficiency scores of other groups was smaller than that of Turkish average value. The share of the beekeepers having the allocative efficiency scores more than Turkish average value increased when moving from small size to the large one ($\chi^2 = 6{,}197, p < 0{,}05$).

It was clear based on the results of efficiency analysis that economic efficiencies of Turkish beekeepers varied between 0,24 and 1, and it was 0,63, on average. Inefficient beekeepers would decrease their production cost by 37% to become efficient one. The mean values of economic efficiency scores of different beekepeer's group were statistically different at the 1% significance level. Localized permanent beekeepers should decrease their production cost by 29%, while that of itinerant beekeepers was approximately 40%. These

decreases for specialized and mixed beekeepers were 39% and 35%, respectively. Economic efficiency of hobby purposed and subsidiary beekeepers were higher than Turkish average value. However, professional and itinerant inter region beekeepers had the lower economic efficiency scores comparing to Turkish average value.

The bias and the lower and upper bounds of the efficiency scores were depicted in table 3.5. Based on the figures presented in Table 7, the confidence intervals for efficiency scores did not vary considerably over the re-samples.

Table 7: Confidence Intervals Bounds for the Efficiency Measures

Efficiency measures	Standard DEA estimation	Bias	SE_{boot}	Lower bound*	Upper bound*
Economic efficiency (EE)	0,63	+0.051	0.036	0.559	0.700
Allocative efficiency (AE)	0,75	+0.054	0.042	0.668	0.832
Technical efficiency (TE)	0,84	+0.050	0.033	0.775	0.904

*95% of the confidence interval

The results of bootstrapping showed that the lower and upper bound of technical efficiency scores for beekeepers were 0.775 and 0.904, respectively while that of allocative efficiency scores were 0.668 and 0.832. The overall economic efficiency scores varied from 0.56 to 0.70.

Efficiency analysis also showed that the main inefficiency source was allocative inefficiency in Turkey. It meant that monitoring both factor and output market and adjusting their input use considering the input prices were basic problems for Turkish beekeepers. Allocative inefficiency was the lesser problem for hobby purposed beekeepers comparing to others. However, the technical inefficiency of they was more problematic than others. Observing the smallest economic efficiencyin small size beekeeping enterprise, itinerant inter region, professional and specialized beekeepers comparing to other group members inferred that there was in need of adjusting the management type of Turkish beekeepers.

4.2. Efficiency determinants

The effects of the variables of itinerancy, credit use and annual revenue on economic effficiency varied associated with the size of beekeeping enterprises. Itinerancy affected the economic efficiency negatively in small and medium size beekeepers' enterprise while the case was the reverse in large beekeeping enterprise ($p<0,01$). On the other hand, incrasing credit use led to increase in efficiency scores. Credit use variable had the negative influence on economic efficiency in medium and large size beekeeping enterprise ($p<0,01$). Regarding

the annual revenue, economic efficiency scores were positively affectedby revenue an all size of beekeepers. However, the effect of schooling variable on economic efficicency was not statistically significant due to the education level of Turkish beekeepers was nearly the similar (p<0,10).

In small size beekeeping enterprise, the variables of the age of beekeepers, tendency to be professional, increasing the distance for itinerancy and number of hive affected the economic efficiency negatively, while the effect of credit use and revenue was positive (p<0,01; Table 8).

Table 8: Economic efficiency determinants of sample beekeepers by enterprise size

Variables	Small		Medium		Large	
	β	Std. error	β	Std. error	β	Std. error
Demographic characteristics						
The age of beekeepers (year)	- 0.00186***	0.00066	-0.00253	0.00249	0.00967***	0.00151
Schooling (year)	0.00199	0.00243	-0.01742	0.01728	0.00591	0.00515
Course participation (unit)	0.00325	0.00697	-0.11407**	0.04929	-0.06402***	0.01268
Enterprise characteristics						
Profession[1]	-0.08986***	0.01481	-0.15795**	0.07206	-0.02400	0.03346
Migration[2]	-0.04579***	0.01267	-0.31724**	0.15133	0.08396**	0.03972
Production system[3]	-0.01926	0.02011	0.36345*	0.20812	0.23595***	0.04607
Number of colony (unit)	-0.00017***	0.00861	-0.11445**	0.05540	-0.06377	0.04501
Record keeping[4]	0.01835	0.01937	.12982	0.08203	0.10986***	0.02820
Economic characteristics						
Credit use ($/year)	0.00001***	0.00001	-0.00011**	0.00005	-0.00007***	0.00002
Revenue per colony ($/year)	0.00069***	0.00034	0.00212***	0.00063	0.00048***	0.00085
Marketing style[5]	-0.01278	0.01219	0.02853	0.06803	-0.42362***	0.06681

*, **, *** reflects the coefficiencts were statistically significant at the level of 1%, 5% and 10%, respectively
[1]Proxy variable, 1 reflected the hobby, while that of subsidiary and professional were 2 and 3, respectively.
[2] Localized permanent, itinerant intra province and itinerant inter region beekeepers were assigned 1, 2 and 3, respectively.
[3] Dummy variables, if the production system of beekeepers was mixed, we assigned 1, otherwise 0.
[4]Dummy variables, if the beekeepers kept management record, we assigned 1, otherwise 0.
[5] 1, 2 and 3 reflected the wholesale, mixed and retail, respectively.

The most magnificance factor influenced the economic efficiency was profession. When the small Turkish beekeepers moved from hobby purposed to professsion one, their economic efficiency scores increased. Itinerancy was the second order variable affected economic efficiency. For small size beekeepers, being itinerant inter region reduced the economic efficiency scores. It meant that small size beekeepers should prefer to be localized permanent or itinerant intra province beekeeper. The third and fourth order variables were the age of beekeepers and number of hive, indicating that economic efficiency would increase if the beekeeping enterprise managed by youngerbeekeeper and had much more hive. The last factor influenced the economic efficiency was credit use. Incresing more credit usesin order to

meet their working capital needs led to increase in economic efficiency of small size beekeeping enterprise.

In the medium size beekeeping enterprise, the variables of course participation, profession, itinerancy, number of hive and credit use affected the economic efficiency negatively ($p<0,05$). However, the variables of production system and annual revenue had the positive effect on economic efficiency. The most magnificence factor influenced the economic efficiency was production system, indicating that the economic efficiency would increase if medium size beekeeping enterprise marketed queen or colony together with bee products such as honey etc. For medium size beekeepers, being itinerant inter region reduced the economic efficiency scores, indicating that medium size beekeepers should prefer to be localized permanent or itinerant intra province beekeeper rather than inter region itinerant.The third order factor influenced the economic efficiency was profession. When the medium beekeepers moved from hobby purposed to professsion one, their economic efficiency scores increased. On the other hand, course participation variable had the positive effect on economic efficiency. If the course participation focusing on marketing issue rather than technical side of beekeeping increased, economic efficiency of medium size beekeepers would increase. However, the credit use variable affected the economic efficiency of medium size beekeepers negatively.

The variables of course participation, credit use and marketing style influendec the economic efficiency negatively ($p<0,01$), while the effects of age of beekeepers, itinerancy, production system, recod keeping and revenue were positive in large size beekeeping enterprise ($p<0,05$). Marketing style variable was the most magnificence factor on economic efficiency. If the large size beekeepers preferred to market their products in retail market, economic efficiency of they would increase. However, usingboth retail and wholesale rather than concentrated to retail market fully was more appropriate strategy for medium size beekeepers due to problems arise in retail market at the beginning and liquidity. Tendency to market queen or colony additionaly to the bee products such as honey etc would increase the economic efficiency of large size beekeeping enterprise. On contrary to small and medium size beekeeping enterprise, being inter region itinerant beekeepers increased the economic efficiency of large beekeepers. Increasing course participation and decreasing credit use made the large beekeepers more efficienct.

Despite there have been no study focusing on directly economic efficiency determinants, there has been some effort to explain technical efficiency of beekeeping. Vural

and Karaman (2009) emphasized that increasing efficiency level was more important than increasing colony number. However, they did not indicate how to do it. Aburime et al. (2006) recommended labor reduction to increase technical efficiency of Nigerian beekeepers in their research. Ören et al. (2010) reported that there were no statistically significant relationship between technical efficiency and age, schooling and experience of beekeepers, while that of the number of colony was statistically significant in Turkey. Abdul-Malik ve Mohammed (2012) suggested that profession and age of the beekeepers were the basic determinants of technical efficiency in Ghana. They also stated that conducting the beekeeping activities by young and more professional beekeepers rather than hobby increased the technical efficienct level of beekeepers in Ghana.

5. Conclusion

Based on the research findings it was clear that 66% of the Turkish beekeepers was small and focused on solely honey production, ignoring the other management style. Also, their education level of beekeepers and record keeping habits level was unsatisfactory level. Most Turkish beekeepeers were older and itinerant. On the other hand, technical, allocative and economic inefficiencies were 0,16, 0,25 and 0.38, respectively, indicating that the production efficiency of Turkish beekeeping enterprises was unsatisfactory level. Efficiency analysis also showed that the main inefficiency source was allocative inefficiency in Turkey. That is why, monitoring theinput and output markets and adjusting factor distributions considering the input prices were basic problems for Turkish beekeepers.

Under the light of the research findings, Turkish beekeepers needtraining and educationabout marketing, queen rearing and bee disease. Current beekeepers' education program in Turkey should be enriched by adding marketing content. Education programenhanced marketing content should be held by marketing expert focusing on quality, market planning, packing and promotion.When planning the training and education programs for beekeepers, places and time utility of beekeepers should be considered. Practical post harvest and pre season education programs will hold in education center established by beekeepers union and in October and March every year to minimize the production losses.

Increasing the interactionbetween Turkish beekeepers and overseas beekeepers and enhancing the machinazation capacity by means of government intencive may be beneficial to increase the efficiency level of beekeepers. At the same time, Turkish beekeepers should decrease the costs of nutrition and transportation to reach fully technical efficiency.

Calculating the cost and benefit of itinerancy may optimize the economic efficiency of Turkish beekeepers.

Since the economic efficiencylevel varied by profession, production system, itinerancy and size, policy makers should pay attention to these differences when developing policy or strategy. Focusing on mixed management type and record keeping may increase the efficiency in medium and large scale beekeepers. Orientation of small and medium size beekeepers to sustain beekeeping as subsidiary sources of income and adopting the large scale beekeepers to mixed management type may increase the production efficiency in Turkey.

Current production inefficiency in Turkish beekeeping creates the doubt about the sustainability of the beekeeping in Turkey. Therefore, the sustainability of the beekeeping highly depends on the preference of the young rural people in Turkey. Organizing education program to stimulate the young rural people aged 18-25 and establisihing special credit opportunities to they may increase the attractivenees of the beekeeping among youg rural people.

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