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Socio-Economic Analysis of Beekeeping and the Effects of Beehive Types on Honey Production

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Abstract

Turkey has considerable potential in beekeeping with her rich flora, proper ecological conditions and existence of colony. However Turkish beekeeping sector has not utilized the rich natural resources sufficiently. Turkey is one of the most important honey producer countries. In Turkey, 200 000 agricultural organizations have activities in apiculture. But, only 20 000 of these organizations deal with apiculture as their main source of income. Apiculture sector in Turkey still has faced to some important problems with respect to high chemical use in the hives and marketing and export problems caused by quality of honey, mix harvest, and so on. The aim of this research is to analyze of apiaries' technical and economic aspects in Turkey. The total numbers of surveyed of apiaries in Bursa province of Turkey are 80 in 2008 production period. Although it has high quality honey production, Bursa province has the highest quality pollen production in Turkey. First of all, technical and economic aspects of beekeepers are given under three sub-groups by the number of colonies (50≥, 51-100, 101≤). One of the principal factors is use of the old types of beehive. In this paper, the effect of old and new type beehive use on the honey production in Turkey has been examined. A time series data between 1936 and 2005 has been used in analyzing by ARD model.

Keywords: beekeeping, socio-economic analyses, time series, ARD model

Introduction

Apiculture is one of the most widespread agricultural activities that are practiced all over the world. Turkey, with its rich flora, suitable ecology and with the existence of colonies, has a great potential in apiculture. The place of origin of 70 % of the honeyed plants that grow in the world is, Anatolia. However, Turkish apiculture cannot take advantage of the rich natural resources it has (Tzob, 2006). In Turkey, 200.000 agricultural organizations have activities in apiculture. But, only 20.000 of these organizations deal with apiculture as their main source of income.

Today, 56 million bee hives exists in the world and 1.2 million tons of honey is produced from these hives. ¼ of produced honey is subject to trade and %90 of the exports come from nearly 20 honey producing countries (www.fao.org). World honey production per bee hive is around 20 kg and this amount is 33 in China, 40 in Argentina, 27 in Mexico, 64 in Canada, 55 in Australia, 40 in Hungary and approximately 16 kg in Turkey. Although the other countries have neared their full capacity in terms of colony number and honey production, the increase in Turkey is perpetually continuing.

In Turkey, we can see that honey production is increasing in parallel to the increase in new type hive numbers. Honey production has shown a rapid increase in between 1936-2005 and reached to 82.336 tons in 2005 (Tuik, 2005). At the end of the same term bee hive numbers reached to 4.590.013 and % 3.42 of these hives is old type hives and the remaining %96.58 is new type.

There are many research have been made on economics of honey production (Cicek, 1993; Akdemir *et al.*, 1993, Habibullah, 1995; Wenning, 2001; Chaudhary, 2001)but there is still need for research, especially in national and international level. The focus of this research is to evaluate, the socio-economic and technical characteristics of beekeepers under the light of survey in terms honey production, organization and marketing problems in Bursa province of Turkey. In addition to economic analyses in this study, Bounds Testing approach that was developed by Pesaran *et al.* (2001) was used to determine the short and long term effects of bee hive types on the production of honey. Firstly, hive type and the progresses of the honey production are evaluated. At the last part applied method and the estimation results is mentioned.

Materials and methods

This research was carried out in order to analyze 80 beekeepers in Bursa province of Turkey. Data, the technical and economic aspects of honey production, socio-economic features of selected apiaries, annual activity results are given. A total of 80 beekeepers are surveyed. Technical and economic aspects of beekeepers are given under

three sub-groups by the number of colonies (50≥, 51-100, 101≤). Individual analyses, group averages and number of colonies.

In this study, the below econometric model has been developed in order to estimate the effect of the change in the numbers of old and new type hives on the honey production.

$$\ln BU_t = \beta_0 + \beta_1 \ln ES_t + \beta_2 \ln YN_t + u_t$$

In this model, BU: annual honey production (000 ton), ES: number of old hives (000 pieces); YN: number of new hives (000 pieces), Ln: Natural logarithm

The Autoregressive Distributed Lag (ARDL) method, which has been estimated by using least squares method, is applied to the 1936-2005 times series data that relates to variables that exist in honey production model. In order to analyze the dynamic interaction and long term connection between the variables of the Honey Production Model, Bounds Testing approach that was developed by Pesaran et al. (2001) has been used. Results and discussion

Technical aspects of honey production

Beekeepers surveyed in Bursa province work 12.35% as static, 42.83% as wanderer beekeeping in the city and 44.82% as wanderer beekeeping between regions. The type of technical beehives is Langsthrot type, but there are also primitive or mixed beehives. Bees have been raised as cross-breed, mixed breed and Kafkas breed bees.

While some beekeepers follow recent news and developments about beekeeping from some articles or magazines, the others can't follow these developments. The queen of colony generally has been changed in two years. Beekeepers recognize important diseases and harms and to deal with them demand aid from formal foundations and expert beekeepers. Primary vaccinates have been done in spring and autumn.

In spring, general cleaning and feeding have been done in beehives. Honey, honey syrup, sugar syrup and cake have been used in feeding. This process has been done with cribs in wrapped woods and cribs which are set into the beehives. Feeding generally has been started in March.

Natural swarms of bees have been taken in April and the most swarms taken in May. Also, some producers yield fake swarms. The first honeys have been set into the beehives in May or June. Honey harvest starts in July. Producers take some kind of honey products as, honey candle, pollen, swarm and major bee products. The most interest is in to the pollens in Bursa province.

Although generally honey has been marketed as filtered honey, there are also beekeepers who sell honeycomb. While packing honey, mostly glass package has been preferred. Many heating process have been used while preparing honey. Almost all of the medium and grand beekeepers have honey filtering machine.

While production method has been applying to the beehives at outside, the end the June some producers migrate their colonies to the Trakya region for sunflower honey. Colonies have entered into the winter with five frames. During production process, narrowing method has been applied in to the flight holes. The major reasons of winter damages are colonies without queen bee and hunger. For this reason, while entering into the winter season approximately between 5-10 kg honey has been put into the beehives. While making cake, generally powder sugar and honey have been used.

Some problems in the activities of beekeepers have been stated; deficiency of qualified queen, lack of standards in beehives and materials, using of pesticide, problems in choosing suitable place, inadequate advertising of bee products to consumers and marketing problems.

Socio-economic characteristics of the beekeepers surveyed

The average age of the beekeepers was 43.88 and they had an experience about 14.05 years of beekeeping. Also beekeepers had approximately 6.5 years education and family population per apiary was over 4 persons (Tab. 1.). Total land was 4.75 hectares in these apiaries and 94.48 % of total land was own property of beekeepers in general average. Honey production has important place, other important agricultural products after honey are found tomato and olive in this study. Average number of colonies changes from 67.44 and to 280.49 by groups. In these beekeepers, average colonies size was 168.40 (Tab. 2.).

Tab. 1. Socio-economic indicators of beekeepers surveyed

Socio-economic indicators	Group 1 ≥50 colonies	Group 2 51-100 colonies	Group 3 101≤ colonies	Average
Age of beekeeper	42.05	44.57	45.03	43.88
Education level (year)	5.75	6.20	7.68	6.54
Experience on beekeeping (year)	9.85	14.54	17.77	14.05
Family population (person)	4.25	4.82	5.66	4.91
Average number of colonies	67.44	157.26	280.49	168.40
Specialization on beekeeping	6	25	17	42
Beekeeping +other agr.activities	14	15	3	38

Tab. 2. Honey production and yield in apiaries surveyed

Groups	Average number of colony	Honey production (kg)	Yields per colony (kg)
Group 1 ≥50 colonies	67.44	1581.47	23.45
Group 2 51-100 colonies	157.26	4508.64	28.67
Group 3 101≤ colonies	280.49	7491.89	26.71
Average	168.40	4527.33	26.28

The study shows that beekeeping is a main source of income (68.40%) for beekeepers who own more than 160 colonies. While first group beekeepers with less than 50 hives earns up 34% of total income from beekeeping, third group earns up 87.63% of total income from only beekeeping. Generally, these apiaries are semi-specialized (Tab. 1.).

In this study, honey production changed from 1581.47 kg to 7491.89 kg per farm by size of colonies and average honey production per farm was 4527.33 kg for 168.40 colonies during 2008 production year (Tab. 2.). The average honey yield was determined to be 26.28 kg per colony which is considerably above the stated national average (16 kg). When honey yield per hive was compared among the groups by size of colony, it ranged from 23.45 kg for Group 1 to about 28.67 kg for Group 2, 26.71 kg for Group 3.

According to results of this study, 35 % of these beekeepers sell honey to dealer (wholesaler) at farm gate, 27.5 % of beekeepers take it to local market for retail sales directly to consumers. While 27.5 % of them sell honey to beekeeping union (Bee Producers Union in Bursa Province), 10 % of them sell it to industry firm (Tab. 3). Generally they have packaged honey into glass jars (1–1.5 kg) or tins (27-28 kg) and they haven't any label for sales.

Most of these beekeepers produce extracted honey. Honey production has exporting potential for food industry. But it still has some problems in the production and marketing. Therefore it can be stated that with the efficient marketing system, in this way problems can be overcome.

The average producer prices (wholesale price) for extracted honey determined in 2008 in surveyed beekeepers are given Tab. 3 by groups. The beekeepers gained the highest of extracted honey price (approximately 7.14 (€/kg) when they sold directly to the consumer in packaged of glass jars, but honey producer prices in wholesales are lower than retail producer prices in apiaries surveyed. In Bursa province, the producer prices (wholesale price) for extracted honey is € 3.64 per kg respectively.

Development in honey production and bee hive types in turkey

In Turkey, we can see that honey production is increasing in parallel to the increase in new type hive numbers. Honey production has shown a rapid increase in between 1936-2005 and reached to 82.336 tons in 2005 (Tuik, 2005). At the end of the same term bee hive numbers reached to 4.590.013 and 3.42 % of these hives is old type hives and the remaining 96.58 % is new type.

Co-integration test:

The ECM model that has been created for bounds test approach of this study is as follows:

$$BU_t = \beta_0 + \sum_{i=1}^{m} \beta_{1i} BU_{t-i} + \sum_{i=0}^{n} \beta_{2i} ES_{t-i} + \sum_{i=0}^{p} \beta_{3i} YN_{t-i} + u_t$$

To determine the effect of hive types on honey production in long term, the UECM model is used. According to Pesaran *et al.* (2001), the f statistics version of Bounds Test is Walds Test. With this test, it is checked that if one lagged stage variable coefficients of the UECM are compositely zero or not.

Bounds test results are shown on Tab. 5. The lag number that is obtained from Tab. 4 can be sensitive to sampling size and VAR value (Bahmaani-Oskooee and Bohl 2000). So, for both models, with or without trend, for the first difference of every variable in each model, p=3 lag is chosen and F-statistics is calculated to test the level variables' lag compound. F-statistics and t values that is calculated for each lag value, is valid for two independent

Tab. 3. Honey marketing channels of apiaries surveyed and honey (wholesale) prices

Marketing Chains	Group 1 ≥50 colonies	%	Group 2 51-100 colonies	%	Group 3 101≤ colonies	%	General	%
Industry	1	5.00	5	12.50	2	10.00	8	10.00
Wholesaler	6	30.00	14	35.00	8	40.00	28	35.00
Union of beekeepers	2	10.00	13	32.50	7	35.00	22	27.5
Retail sales	11	55.00	8	20.00	3	15.00	22	27.5
TOTAL	20	100.00	40	100.00	20	100.00	80	100.00
Extractedhoney price (€/kg)	3.35	-	3.74	-	3.82	-	3.64	-

Tab. 4. Lag number of Honey Production Model

	Deterministic by Trend			Deterministic off Trend		
p	AIC	SBC	LM(1)	AIC	SBC	LM(1)
1	-1.928	-1.667	0.212	-1.924	-1.696	0.071
2	-1.839	-1.477	0.710	-1.835	-1.506	0.030
3	-1.800	-1.336	0.782	-1.759	-1.328	1.381
4	-1.790	-1.221	1.109	-1.701	-1.166	0.824

variables and 5 % significance level. As seen on Tab. 5 -the calculated F-statistics (Fv and Fm) - the first two lags' critical values are high. But, t-statistics is above the critical value for only p=1 lag. These results, are proof that for p=1 lag number, there is a long term relation between the variables of the honey production model. Also, this situation shows that there is not a spurious regression problem in the analyses that will be made on the three variables' level values. In choosing with or without trend model the trend coefficients importance level is taken into account. With UECM, it is determined that trend coefficient is insignificant at 5% importance level and too close to zero. So, it is concluded that the short and long term analyses should be done by using without trend model. Long term connection:

Tab. 5. Results of Bounds Test

	Deterministic by Trend			Deterministic off Trend	
p*	F_{IV}	F_V	t_V	F_{III}	t_{III}
1	6.355[c]	8.290[c]	-4.450[c]	7.686[c]	-4.672[c]
2	3.890[b]	4.923[c]	-3.204[a]	4.466[c]	-3.529[b]
3	3.694[b]	4.280[b]	-2.556[a]	3.448[b]	-2.912[b]
For k=2, critic values: F_{IV} (3.88,4.61) and F_V (4.87, 5.85) ; F_{III} (3.79, 4.85) t_V (-3.41,-3.95) t_{III} (-2.86, -3.53)					

c, high from %5 ; b, middle on %5; a, low from %5

After determining long term connection between three variables with bounds test approach, below ARDL (m,n,p) model is estimated by using p=1 lag length. Estimated model rests on minimization of Akaike information criteria:

$$BU_t = \beta_0 + \sum_{i=1}^{m} \beta_{1i} BU_{t-i} + \sum_{i=0}^{n} \beta_{2i} ES_{t-i} + \sum_{i=0}^{p} \beta_{3i} YN_{t-i} + u_t$$

Long term coefficient estimations are shown on Tab. 6. As expected, old type beehive variable's coefficient is negative and new type beehive variable's coefficient is positive. Both variables are significant at 1% importance level. While all the other variables remain same, it is expected that, the 1% increase in old type hive numbers will cause a decrease of 0.29% in honey production; the 1% increase in new type hive numbers will cause an increase of 0.47% in honey production.

Tab. 6. Estimated results of ARDL(1,0,1) model

Variables	Coefficient	t-statistic	p-value
BU_{t-1}	0.246	2.10	0.04
ES_t	-0.219	-4.96	0.00
YN_t	0.137	1.67	0.10
YN_{t-1}	0.214	2.59	0.01
C	5.728	5.46	0.00
Estimated coefficients for long term:			
ES_t	-0.291	-9.856	0.00
YN_t	0.466	38.171	0.00
C	7.600	14.476	0.00
Test of model:			
R^2:	0.993	Adjusted R^2:	0.993
F(4,64)-sta.	2252.9(0.00)	c^2_{RAMSEY}	1.468(0.23)
c^2_M	0.103(0.75)	c^2_{WHITE}	0.152(0.70)

Short Term Connection:

After researching the long term connection, the error correction model, which is built on ARDL approach that is used to determine the effects of hive types on honey production in short term, is as follows:

$$BU_t = \beta_0 + \sum_{i=1}^{m} \beta_{1i} BU_{t-i} + \sum_{i=0}^{n} \beta_{2i} ES_{t-i} + \sum_{i=0}^{p} \beta_{3i} YN_{t-i} + u_t$$

The EC_{t-1} variable in the error correction model is the one term lagged value of the residual series that is reached by the long term connection. Error correction coefficient is the coefficient that is reached by estimating the error correction model with OLS. Error correction coefficient shows how fast the instability that is caused by the policies that is used on honey production can be corrected. Equilibrium values are long term coefficient estimations. The rate of correction is explained by error correction term. It is expected for the error correction coefficient to be negative. After the economic shocks that occurred in honey production, if short term equilibrium values cause too much increase on long term equilibrium values, correction rate drops. If the short term equilibrium values are lower than long term equilibrium values, correction rate should increase. Another important characteristic of the error correction coefficient is its value. Since we expect this coefficient value to be between 0 and 1 and be negative, if the coefficient's absolute value increases more the honey production nears to equilibrium value faster.

Tab. 7 shows the estimations of the error correction model of the honey production model that is reached from the ARDL model. Disequilibrium error coefficient (EC) is estimated as -0,754. It has the expected sign and is significant at 1% importance level. Its probability to correct equilibrium after a possible shock at any time is high.

Tab. 7 Error correction coefficients of ARDL(1,0,1) model

Variables	Coefficient	t-statistic	p-value
ΔES_t	-0.219	-4.956	0.00
ΔYN_t	0.137	1.670	0.10
C	5.728	5.463	0.00
EC_{t-1}	-0.754	-6.425	0.00

The 75% of the disequilibrium that occurred at a previous year will converge to long term equilibrium in a year.

Conclusions

The basic target of this study is to determine if there is a connection between old and new types of hives and honey production amount in Turkey and socio-economic analysis of beekeeping in Bursa Province.

In this study, some problems in the activities of beekeepers have been stated; deficiency of qualified queen, lack of standards in beehives and materials, using of pesticide, problems in choosing suitable place, inadequate advertising of bee products to consumers and marketing problems. Honey production has exporting potential for food industry. But it still has some problems in the production and marketing. Therefore it can be stated that with the efficient marketing system, in this way problems can be overcome.

According to the econometric analysis results that have been done in this context, while all the other variables remain same, 1% increase in old type hives will cause a decrease of 0.29% in honey production and 1% increase in new type hives will cause a 0.47% increase in honey production. However there are other factors that increase honey production aside from hive types. For example, even though Turkey is one of the considerable honey producers in the World, it doesn't have an effective structure in World markets. An important reason for this is that, honey production activity is not seen as a commercial activity (İşyar, 1977). Honey producers don't produce according to economic conventions and also don't have enough information about the subject. So honey production falls behind in quality in domestic markets (Vural, 2008). Also in apiculture what is important is not the increase in colony numbers but the increase in efficiency levels.

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