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Full Length Research Paper

Socio-economic analysis of beekeeping and the effects of beehive types on honey production

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Turkey has considerable potential in beekeeping with her rich flora, proper ecological conditions and existence of colony. However, Turkish beekeeping sector has not yet 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 is faced with some important problems with respect to high chemical use in the hives, marketing and export problems caused by quality of honey, mix harvest and so on. The aim of this research was to analyze apiaries' technical and economic aspects in Turkey. The total numbers of surveyed apiaries in Bursa province of Turkey were 80 in 2008 production period. Bursa province has high quality honey production and 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, and 101 ≤). One of the principal factors is use for the old types of beehive. In this paper, the effect of old and new type beehive use for the honey production in Turkey was examined. A time series data between 1936 and 2005 was used in analyzing ARD model.

Key words: 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 has not taken 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 beehives exist in the world and 1.2 million tons of honey is produced from these hives. The ¼ of the 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 beehive 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, honey production is increasing parallel to the increase in new type hive numbers. Honey production showed a rapid increase from 1936 - 2005 and reached 82.336 tons in 2005 (TUĐK, 2005). At the end of the same term beehive numbers reached 4.590.013 and 3.42% of these hives was old type hives and the remaining 96.58% was new type hives. There are many researches that have been made on the 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 was to evaluate the socio-economic and technical characteristics of beekeepers under the light of survey in terms of honey production, organization and

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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 beehive types on the production of honey. Firstly, hive type and the progresses of the honey production were evaluated at the last part, the applied method and the estimation results were mentioned.

MATERIALS AND METHODS

This research was carried out in order to analyze 80 beekeepers in Bursa province of Turkey. Data of the technical and economic aspects of honey production, socio-economic features of selected apiaries and annual activity results are given. A total of 80 beekeepers were surveyed. Technical and economic aspects of beekeepers were given under three sub-groups by the number of colonies (50 ≥, 51 - 100, and 101 ≤) individual analyses, group averages and number of colonies.

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

$$\text{LN}\, BU_t = \beta_0 + \beta_1 \text{LN}\, ES_t + \beta_2 \text{LN}\, YN_t + u_t$$

In this model, BU = annual honey production (000 ton), ES = number of old hives (000 pieces), YN= number of new hives (000 pieces) and Ln = Natural logarithm. The autoregressive distributed lag (ARDL) method, which was estimated by using least squares method, was applied to the 1936 - 2005 times series data that related 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) was used.

RESULTS AND DISCUSSION

Technical aspects of honey production

Beekeepers surveyed in Bursa province worked 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 was Langsthrot type, but there were 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 did not follow the developments. The queen of colony generally was changed in two years. Beekeepers recognize important diseases and harms and to deal with them, they demand aid from formal foundations and expert beekeepers. Primary vaccinations is done in spring and autumn.

In spring, general cleaning and feeding was done in beehives. Honey, honey syrup, sugar syrup and cake have been used in feeding. This process was done with cribs in wrapped woods and cribs which are set into the beehives. Feeding generally was started in March. Natural swarms of bees were taken in April and most swarms were taken in May. Also, some producers yielded fake swarms. The first honeys were set into the beehives in May or June. Honey harvest started in July. Producers take some kind of honey products as, honey candle, pollen, swarm and major bee products. The most important is the pollens in Bursa province.

Although, generally honey has been marketed as filtered honey, there are also beekeepers who sell honeycomb. Glass package has been preferred for honey packaging. Many heating processes are used when preparing honey. Almost all of the medium and grand beekeepers have honey filtering machine. After production method has been applied to the beehives outside, at the end of June some producers move their colonies to the Trakya region for sunflower honey. Colonies enter into winter with five frames. During production process, narrowing method was applied into the flight holes. The major reasons of winter damages are colonies without queen bee and hunger. For this reason, when entering into the winter season approximately between 5 - 10 kg honey was put into the beehives. When making cake, generally powder sugar and honey is used. Some problems in the activities of beekeepers have been stated; deficiency of qualified queen, lack of standards in beehives and materials, the use of pesticide, problems in choosing suitable place and inadequate advertisement 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 of about 14.05 years of beekeeping. Also, beekeepers had approximately 6.5 years of education and family population per apiary was over 4 persons (Table 1). Total land was 4.75 hectares in these apiaries and 94.48% of total land was own by the beekeepers in general. Honey production has important place, other important agricultural products after honey were found to be tomato and olive in this study. Average number of colonies changed from 67.44 - 280.49 by groups. In these beekeepers, average colonies size was 168.40 (Table 2). The study showed 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 earned up to 34% of total income from beekeeping, the third group earned up to 87.63% of total income from only beekeeping. Generally, these apiaries are semi-specialized (Table 1).

In this study, honey production changed from 1581.47 - 7491.89 kg per farm by size of colonies and average

Table 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 agricultural activities	14	15	3	38

Table 2. Honey production and yield in apiaries surveyed.

Group	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

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

Marketing chain	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
Extracted honey price (€/kg)	3.35	-	3.74	-	3.82	-	3.64	-

honey production per farm was 4527.33 kg for 168.40 colonies during 2008 production year (Table 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 and 26.71 kg for Group 3.

According to the 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 industrial firm (Table 3). Generally, they packaged honey into glass jars (1 -1.5 kg) or tins (27 - 28 kg); they have no 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 shown in Table 3 by groups. The beekeepers gained the highest extracted honey price (approximately 7.14 (€/kg) when they sold directly to the consumer in packaged glass jars, but honey producer prices in wholesales are lower than retail producer prices in the apiaries surveyed. In Bursa province, the producer prices (wholesale price) for extracted honey was € 3.64 per kg, respectively.

Development in honey production and beehive types in Turkey

In Turkey, it was observed that honey production

Table 4. Lag number of honey production model.

p	Deterministic by trend			Deterministic off trend		
	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

Table 5. Results of bounds test.

p*	Deterministic by trend			Deterministic off trend	
	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, and 5.85); F_{III} (3.79. 4.85) t_V (-3.41 and -3.95) t_{III} (-2.86 and -3.53); c, high from 5%; b, middle on 5%; a, low from 5%.

increased in parallel to the increase in new type hive numbers. Honey production showed a rapid increase from 1936 - 2005 and reached 82.336 tons in 2005 (Tuik, 2005). At the end of the same term bee hive numbers reached 4.590.013 and 3.42% of these hives were old type hives and the remaining 96.58% were new types.

Co-integration test

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

$$BU_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} BU_{t-i} + \sum_{i=0}^{n} \beta_{2i} ES_{t-i} + \sum_{i=0}^{n} \beta_{3i} YN_{t-i} + \beta_{4t-1} BU + \beta_{5t-1} ES + \beta_6 YN_{t-1} + \beta_7 t + u_t$$

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

The Bounds test results are shown in Table 5. The lag number that is obtained from Table 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 was chosen and F-statistics was calculated to test the level variables' lag compound. F -statistics and t values that was calculated for each lag value, was valid for the two independent variables at 5% significant level. As shown in Table 5, the calculated F-statistics (F_V and F_m) - the first two lags' critical values were high but, t-statistics was 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 no 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 was taken into account. With UECM, it was observed that trend coefficient was insignificant at 5% level of importance and was 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

After determining long term connection between the three variables with bounds test approach, below ARDL (m, n, p) model was estimated by using p = 1 lag length. Estimated model rested 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 Table 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.

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

Variable	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)	χ^2_{RAMSEY}	1.468 (0.23)
χ^2_{LM}	0.103(0.75)	χ^2_{WHITE}	0.152 (0.70)

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

Variable	Coefficient	t-statistic	p-value
ES_T	-0.219	-4.956	0.00
YN_t	0.137	1.670	0.10
C	5.728	5.463	0.00
EC_{t-1}	-0.754	-6.425	0.00

Short term connection

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

$$BU_t = \beta_0 + \sum_{i=1}^{n} \beta_1 BU_{t-i} + \sum_{i=0}^{n} \beta_2 ES_{t-i} + \sum_{i=0}^{n} \beta_3 YN_{t-i} + \beta_4 EC_{t-1} + u_t$$

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 that the error correction coefficient should 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 increases. Another important characteristics 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, then the honey production near to equilibrium value is faster.

Table 7 shows the estimations of the error correction model of the honey production model that was reached from the ARDL model. Disequilibrium error coefficient (EC) was estimated as -0.754. It had the expected sign and was significant at 1% importance level. Its probability to correct equilibrium after a possible shock at any time is high. The 75% of the disequilibrium that occurred at a previous year will converge to long term equilibrium in a year.

Conclusion

The basic target of this study was 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 were stated; deficiency of qualified queen, lack of standards in beehives and materials, the use of pesticide, problems in

choosing suitable places, inadequate advertisement of bee products to consumers and marketing problems. Honey production has exporting potential for food industry but it is still faced with some problems in the production and marketing. Therefore, it can be stated that with efficient marketing system, the problems can be overcome.

According to the econometric analysis results that were done in this context, while all the other variables remained the same, 1% increase in old type hives caused a decrease of 0.29% in honey production and 1% increase in new type hives caused a 0.47% increase in honey production. However, there are other factors that increase honey production apart from hive types. For example, even though Turkey is one of the considerable honey producers in the world, it does not have an effective structure in the world markets. An important reason for this is that, honey production activity is not seen as a commercial activity (Đ yar, 1977). Honey producers do not produce according to economic conventions and also do not 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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