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Assessment of the effects of subsidies to the beekeeping sector in Turkey on the number of hives and amount of honey produced

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ABSTRACT:

The beekeeping sector was included in the scope of government subsidies only after 2000s. The purpose of this study is to assess the effect of extracted honey subsidy granted to the beekeeping sector between 2003 and 2007 and the hive subsidy granted based on the number of hives, regardless of the amount of production, since 2008 on the number of hives and the amount of honey production. The material of the study consists of the data from the Turkish Statistical Institute's (TURKSTAT) databases and the AKS (Beekeeping Registration System). The study addresses the figures regarding the amount of honey production, number of hives, yield per hive in the two different subsidy periods as well as the changes in these figures over time. Binary Logistic Regression analysis was employed to identify the relationship between the independent variables and dependent variables. The differences between the number of hives, annual increase in the number of hives and amount of honey production in the two different subsidy periods were found to be statistically significant ($p<0.05$). The risk of honey production falling under the Type 1 subsidy is 4.848 times the risk of honey production falling under the Type 2 subsidy. The tendency of the number of hives to increase under Type 2 subsidy is 1.128 times higher than that under Type 1 subsidy. Switching to the new type of subsidy resulted in a decreasing (negative) trend for honey production, but an increasing trend for total number of hives. Governments are able to steer the development of the sectors by providing subsidies, which applies to the beekeeping sector as well. Due to the abovementioned reasons, the subsidies granted to the beekeeping sector should be aimed at increasing the yield per hive, rather than increasing the number of hives.

Türkiye arıcılık sektöründeki desteklemelerin kovan sayısı ve bal üretim miktarları üzerine etkilerinin değerlendirilmesi

ÖZET:

Hayvancılık sektörleri içerisinde arıcılık sektörü 2000'li yıllardan sonra destekleme kapsamına alınmıştır. Bu çalışmanın amacı arıcılık sektörüne 2003-2007 yılları arasında verilen süzme bal desteği ile 2008 yılından günümüze kadar uygulanmakta olan ve üretim miktarından bağımsız olarak kovan sayısına göre verilen arılı kovan desteğinin yıllar içerisinde arılı kovan sayısı ve bal üretim miktarlarına etkisinin değerlendirilmesidir. Araştırmanın materyalini TÜİK (Türkiye İstatistik Kurumu) ve AKS (Arıcılık Kayıt Sistemi) verileri oluşturmuştur. Çalışmada iki farklı tip destekleme dönemindeki bal üretim miktarı, arılı kovan sayısı, kovan başına verim rakamları ve bunlarda yaşanan değişimler ayrı ayrı ele alınmıştır. Çalışmada bağımsız değişkenler ve bağımlı değişken arasındaki ilişkinin modelinin belirlenmesinde Binary Lojistik Regresyon analizi kullanılmıştır. Destekleme tipinin değişimi ile beraber kovan sayılarındaki farklılık, yıllık bazda kovan sayılarındaki artışlar, bal üretim miktarları arasındaki farklılıklar iki destekleme dönemi için istatistiksel olarak anlamlı bulunmuştur ($p<0.05$). Destekleme tip 1'deki bal üretim miktarındaki azalma riski tip 2'ye geçişteki bal üretim miktarı azalma riskine kıyasla 4,848 kat daha fazladır. Tip 2 desteklemede kovan sayısı miktarında artış gösterme eğilimi, Tip 1 desteklemeye kıyasla 1,128 kat daha fazladır. Destekleme tipindeki değişim bal üretiminde risk faktörü olarak düşüş (negatif) eğilimi gösterirken, toplam kovan varlığında ise yükseliş eğilimi göstermektedir. Devletler desteklemeler aracılığıyla sektörlere yön verebilme yetisine sahiptir, arıcılık sektörü için de bu durum geçerlidir. Yukarıda bahsi geçen tüm nedenlerden dolayı arıcılık sektörüne yönelik desteklemeler kovan sayısını artırmaktan ziyade kovan başına verimi artıracak nitelikte olmalıdır.

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1. Introduction

The beekeeping sector in Turkey has some advantages over other livestock sub-sectors. First, it is not dependent on land/soil and requires only a little amount of capital to start a business. Additionally, the apiculture products, particularly honey, are easier to store than the products obtained from other livestock sub-sectors, including meat, milk, eggs, etc. Despite the inherent challenges of the sector, beekeeping products also have an edge over other livestock products in terms of marketing, and increase the income of the families living in rural areas (1, 11).

The sectoral figures suggest that the Turkish beekeeping sector has been growing every year and already become a dynamic livestock sub-sector, with its volume of production, number of hives and number of enterprises rising with each passing day. The beekeeping figures for the period 2003-2017, including the total number of hives, total production and yield per hive, are given in Table 1 (13).

Table 1: Figures of the Turkish beekeeping sector for the period 2003-2017

Tablo 1: *Türkiye'de 2003-2017 yılları arasında arıcılık sektörüne ilişkin sayısal bilgiler*

Years	Honey Production (ton)	Index	Number of Hives (number)	Index	Yield Per Hive (kg)	Index
2003	69 540	100	4 288 853	100	16,21	100
2004	73 929	106	4 399 725	103	16,80	104
2005	82 336	118	4 590 013	107	17,94	111
2006	83 842	121	4 851 683	113	17,28	107
2007	73 935	106	4 825 596	113	15,32	95
2008	81 364	117	4 750 998	111	16,64	103
2009	82 003	118	5 210 481	121	15,36	95
2010	81 115	117	5 465 669	127	14,48	89
2011	94 245	136	5 862 312	137	15,68	97
2012	89 162	128	6 191 232	144	14,05	87
2013	94 694	136	6 458 083	151	14,25	88
2014	103 525	149	6 888 907	161	15,03	93
2015	108 128	155	7 525 652	175	14,37	89
2016	105 727	152	7 679 482	179	13,77	85
2017	114 471	165	7 796 666	182	14,68	91

Table 1 shows that the total production in Turkey has increased by 65%, reaching 114,471 tons, and the number of honey-producing hives has risen by 82%, reaching around 8 million in the last 15 years. Despite the increase in total production and number of honey-producing hives, no improvement was achieved in the yield per hive in this period. The graph derived from the data in the table is given in Figure 1.

Figure 1: Yield per hive, total honey production and number of hives in Turkey for the last 15 years

Şekil 1: *Türkiye'de son 15 yıla ait kovan başına verim, bal üretimi ve kovan varlığı rakamları*

The graph in Figure 1 shows that the total production and number of honey-producing hives in Turkey have an increasing trend for the last 15 years, but the yield per hive has followed a slightly decreasing trend. Although the yield per hive figures partially increased until 2009, they have been generally falling since 2008. These breaks are illustrated in detail in Figure 1.

The subsidies granted to the beekeeping sector were not as supportive as the subsidies granted to the other livestock sub-sectors in Turkey for years. However, the beekeeping sector was included in the scope of the agricultural subsidies in 2002, and the government started to pay subsidies regarding numerous cost items, including queens, production and use of bumblebees, honey production, honey-producing hives, and exports (12). Subsidies were paid to beekeeping enterprises based on the quantity of extracted honey produced between 2003 and 2008, but then the government switched to another type of subsidy based on the number of honey-producing hives in 2008 (1, 2, 10, 12). While Type 1 subsidy (2003-2008) was based on total output, the new Type 2 subsidy adopted in 2008 involved payment per hive, regardless of total output.

The present study is intended to assess the effect of the two types of subsidies granted to beekeeper enterprises since 2003 on the total number of hives and total production of honey using the logistic regression method.

2. Material and Methods

The primary data were derived from the TURKSTAT's databases and the Beekeeping Registration System (AKS). The secondary data were taken from scientific studies and reports regarding the sector. The data were analysed using SPSS 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) software package (6). The mean±standard deviation, median (maximum-minimum) percentage and frequency values of the variables were used. The variables were tested (Shapiro Wilk and Levene Test) after verifying their normality and homoscedasticity. To assess the differences between the two groups, "Student's t Test" was used where the prerequisites to parametric test were met, and "Mann Whitney–U test" was used where they were not. Binary Logistic Regression (Backward LR) analysis was employed to identify the relationship between the independent variables and dependent variables in the study. The significance level of the tests was assumed to be $p<0.05$ and $p<0.01$ (7).

3. Results

Tests were conducted to determine whether there was a significant difference between the mean values of the number of hives, increase in the number of gives, honey production, increase in production and yield per hive in the two different subsidy periods, and then the change in the number of hives and total production was analysed using the logistic regression method. The descriptive statistics on the changes in the number of hives, total honey production and yield per hive for two different subsidy periods, namely, 2003-2007 and 2008-2017, and the findings obtained from the tests are given in Table 2.

According to the findings on the total number of honey-producing hives, annual increase in the number of hives, total honey production, annual increase in production and average yield per hive in the two different subsidy periods of 2003-2007 and 2008-2017 in Table 2, the total number of honey-producing hives was 4.5 million, the annual increase in the number of hives was around 120,000, the annual increase in total output was 2,364 tons and the yield per hive was 16.71 kg in the period from 2003 to 2007 when Type 1 subsidy was granted. In the second period when the government adopted the Type 2 subsidy, the total number of honey-producing hives was 6.4 million, the annual increase in the number of hives was 323,078, the annual increase in total output was 3,678 tons and the average yield per hive was 14.8 kg. Statistically significant differences were found between the total number of hives, annual increase in the number of hives, total honey production and yield per hive in the period of Type 1 subsidy and the next period when the government adopted the Type 2 subsidy involving payment per hive, regardless of the total output ($p<0.05$). However, no significant difference was found between the amounts of increase in annual average honey production in the two periods.

Table 2: Descriptive statistics by the type of subsidies granted to the beekeeping enterprises in 2003-2007 and 2008-2017

Tablo 2: *Türkiye'de 2003-2007 ile 2008-2017 dönemlerinde arıcılık sektörüne verilen desteklere göre tanımlayıcı istatistikler*

Subsidy Type	2003-2007 (Subsidy Type-1 Period)		2008-2017 (Subsidy Type-2 Period)		Test Statistics	p
	$\bar{x}$±S.D	Median (Min-Max)	$\bar{x}$±S.D	Median (Min-Max)		
Total Hive (x100.000 number)	45.91±2.50	45,90 (42.89-48.52)	64.7±10,2	64.9 (48.9-78)	-3.062	**0.001**[t]
Annual Hive Number Increase (number)	120 021± 111 403	110872 (-26 087-261 670)	323 078± 159 394	293 339 (117 184-636 745)	-2.508	**0.028**[+]
Honey Production (x1000ton)	76.7164±6.11	73,94 (69,54-83.84)	95.4±12.1	94.5 (81,1-114,5)	-3.216	**0.007**[+]
Annual Honey Production Increase (ton)	2 364.8± 7 375.40	4389 (-9 907-8 407)	3 678,6±6 017.1	4 603 (-5 083-13 130)	-0.362	0.723[+]
Yield Per Hive(kg)	16.71±1.00	16,8 (15,32-17,94)	14.8±0.9	14.6 (13.8-16.6)	3.769	**0.002**[+]

[+] *Student's t test*

[t] *Mann Whitney-U Test*

The findings on the model developed using the variables number of hives and total honey production in the two different periods are given in Table 3.

Table 3: Findings from the logistic regression model developed for the effect of subsidies granted in Turkey during the periods 2003-2007 and 2008-2017 on the total number of hives and honey production

Tablo 3: *Türkiye'de 2003-2007 ile 2008-2017 dönemlerinde destekleme tipinin toplam kovan varlığı ve bal üretimine ilişkin kurulan lojistik regresyon modeline ilişkin bulgular*

	B	S.E.	Wald	p	OR
Total Hive (x100.000 number)	62.290	2580.902	0.001	**0.005**	1.128
Honey Production (x1000ton)	-1.544	185.747	0.0001	**0.012**	0.214
Constant	-2906.250	120244.775	0.001	**0.001**	0.001

Table 3 shows that according to the Logistic Regression analysis, switching to the new type of subsidy resulted in 4.848-fold increase in the risk of annual honey production decreasing (x 1000 tons). Switching to the new type of subsidy resulted in 1.128-fold increase in the tendency of the total number of hives (x 100,000 pcs.) increasing annually. Switching to the new type of subsidy resulted in a decreasing (negative) trend for honey production, but an increasing trend for total number of hives. In brief, the change in the type of subsidy resulted in a positive trend for the total number of hives and a negative trend for honey production.

4. Discussion and Conclusion

Despite all efforts, Turkey has not been able to increase its productivity to the desired levels generally in the livestock sectors, and specifically in the beekeeping sector. Environmental factors such as geographical location, climate, vegetation, topographic structures as well as many other factors such as the genotype and level of improvement of bees, and the level of knowledge and skills of beekeepers have an effect on the productivity of colonies (2). The findings obtained suggest that government subsidies should be included in the factors that affect yield per hive.

The number of hives rapidly increased as from 2008 when the government adopted the new type of subsidy involving payment per honey-producing hive. The yield per hive figures indicate that during the Type 1 subsidy period

the yield per hive was around 16-17 kg, except for in 2007 which was an arid year. Starting from 2008 when the Type 2 subsidy was adopted, the number of honey-producing hives rapidly increased, but the yield per hive fell from 16-17 kg to around 14 kg (Figure 1). It may be said that the statistically significant difference between the yield per hive figures in the two subsidy periods arose from the type of the subsidy ($p<0.05$).

The differences between the number of hives, annual increase in the number of hives and amount of honey production in the two different subsidy periods were found to be statistically significant ($p<0.05$). This is probably due to the engagement of beekeeping enterprises in efforts to increase the number of their hives in an attempt to benefit from the government subsidies. While the annual average increase in the number of hives had been 110,872 during the Type 1 subsidy period, it rose to 293,339 in the Type 2 subsidy period. The yield per hive decreased in the same period.

The increase in the total amount of honey produced in Turkey despite the fall in the yield per hive can be accounted for only by the increase in the number of honey-producing hives. The Binary Logistic Regression model developed for this study also confirms this interpretation. Switching from Type 1 subsidy to Type 2 subsidy resulted in a decreasing trend for honey production, but an increasing trend in the number of hives. In other words, Turkey had had the same number of hives since 2008, the total amount of honey produced would have decreased under the current subsidy policy.

Turkey is the second largest honey producer in the world following China in terms of the number of hives and total output. Nevertheless, it ranks in around the 30th place in terms of exported honey and yield per hive. The yield per hive in Turkey in 2016 was 13.8 kg, which was below the world average, 19.7 kg (5). Enhancement of yield per hive is essential to lower the unit production cost and increase profitability (9). This underlines how important the direct and indirect effects of subsidy policies on production are.

In a study conducted among the beekeeping enterprises in TR32 Region (Muğla, Aydın and Denizli), 79% of the producers stated that they were not satisfied with the new type of subsidy involving payment per hive. Beekeeping enterprises further noted that they requested a subsidy based on the quality of the honey produced, that the production of other apiculture products such as pollen, propolis, royal jelly, etc. should be subsidized, and that if the subsidy policy would not be changed, the subsidy payment per hive should be increased (3).

In another study about the beekeeping sector in Malatya, 58.9% of the producers stated that they were not satisfied with the current subsidy policy involving payment per hive. The expectations of the producers interviewed in the study regarding subsidy policies included those that would increase the total output, such as queen subsidy and product subsidy (honey, pollen, etc.) (8).

A study comparing the beekeeping industries of Turkey and Serbia mentioned that instead of direct monetary assistance, technical support was provided to the producers in Serbia, just like the case in the European Union, in many areas including varroa examination, honey analysis, improvement of migratory beekeeping, and augmentation of the number of hives. The two countries' organic beekeeping subsidies involving direct cash payment were also compared, and it was reported that an organic beekeeper in Serbia received 40% higher cash support than a beekeeper in Turkey (4).

A study conducted on beekeeping enterprises found that some seminars held among enterprises that were members of the producer associations/cooperatives, the technical and economic assistance provided and the training courses delivered to them had a positive effect on productivity (14). Thus, the technical support and assistance to be provided to the beekeeping enterprises in Turkey like in the EU model can improve the yield per hive.

The increasing number of hives makes it easier for diseases to spread, raises the cost of transportation in migratory beekeeping and results in extra costs being incurred by producers for each kilogram of honey produced during the periods when yield per hive decreases. Subsidy policies and practices aimed at increasing the yield per hive can help producers achieve a higher amount of production with a lower number of hives. Additionally, avoiding increasing the number of hives excessively would provide some convenience regarding prevention and control of bee diseases. The 1 kg unit cost of production will decrease, level of profitability will increase, and thus the consumers will be able to have access to high-quality money at affordable prices. Governments are able to steer the development of the sectors by providing subsidies, which applies to the beekeeping sector as well. Due to the abovementioned reasons,

the subsidies granted to the beekeeping sector should be aimed at increasing the yield per hive, rather than increasing the number of hives.

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