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Analysis of current beekeeping conditions: A case study in Turkey

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ABSTRACT **Research Article**

Turkey holds a significant place in the globe in terms of bee colonies and honey production because of the country's unique geographical and climate structure. Ordu province ranks first in Turkey for honey production. This study was carried out by interviewing 60 beekeepers from four different districts who were members of the Ordu province beekeeping cooperative to reveal their current beekeeping situation and to determine the factors affecting the adoption of beehives developed to increase honey production. Descriptive statistics and logistic models were used to analyze the data. One of the important findings of the study was that 93% of the beekeepers interviewed use traditional hives while using box hives at the same time. Traditional wooden hives were found to be used instead of box hives for reasons such as excessive humidity, a cold environment for bees, low production and, increased bee disease. Age groups of beekeepers had negatively influenced the adoption of the box hive. The education levels of the participants were primary and secondary education levels and their average age was calculated as 60.72. However, it was determined that 98.3% of the participating beekeepers received formal training in beekeeping. All participants emphasized that forests are very important for beekeeping. While all the participants stated that honey forests are also a useful and appropriate practice, 96.7% (n=58) stated that they were not adequately informed about honey forests. Therefore, the establishment of honey forests in order to rehabilitate the degraded forests and offer them to the forest villagers and rural people is important in terms of reducing the pressure on forests, protecting biodiversity and sustainable rural development.

Key Words: Beekeeper, forestry, honey production, socio-economic

Mevcut arıcılık koşullarının analizi: Türkiye'de bir alan çalışması

ÖZ

Türkiye, sahip olduğu olağanüstü topografik ve iklim yapısının da desteğiyle dünyada arı kolonileri ve bal üretimi açısından çok önemli bir konuma sahiptir. Ordu ili Türkiye'de bal üretiminde ilk sırada yer almaktadır. Bu çalışma Ordu ili arıcılık kooperatifine kayıtlı dört farklı ilçeden 60 arıcı ile görüşülerek mevcut arıcılık durumlarını ortaya koymak ve bal üretimini artırmak için geliştirilmiş arı kovanlarının benimsenmesini etkileyen faktörleri belirlemek amacıyla gerçekleştirilmiştir. Elde edilen veriler tanımlayıcı istatistikler ve lojistik modellerle analiz edilmiştir Görüşülen arıcıların %93'ünün aynı anda kutu kovanları kullanırken hala geleneksel kovanları kullanması çalışmanın önemli bulgularından biri olmuştur. Yüksek nem, arılar için ortamın soğuk olması, verimin düşük olması ve arılarda hastalıkların artması gibi nedenlerle kutu kovan yerine ahşaptan yapılmış geleneksel kovanların kullanılmaya devam edildiği görülmüştür. Katılımcıların eğitim düzeyleri ilk ve orta öğretim düzeyinde olup yaş ortalamaları ise 60,72 olarak hesaplanmıştır. Bununla birlikte katılımcı arıcıların %98,3'ünün arıcılıkla ilgili resmi olarak bir eğitim aldığı tespit edilmiştir. Tüm katılımcılar ormanların arıcılık için çok önemli olduğuna vurgu yapmıştır. Katılımcıların tamamı bal ormanlarının da faydalı ve uygun bir uygulama olduğunu belirtirken, %96,7'si (n=58) bal ormanları hakkında yeterince bilgilendirilmediklerini ifade etmiştir. Bu nedenle bozulmuş ormanların rehabilite edilerek orman köylülerine ve kırsal kesime sunulması amacıyla bal ormanlarının kurulması, ormanlar üzerindeki baskının azaltılması, biyolojik çeşitliliğin korunması ve sürdürülebilir kırsal kalkınma açısından önemlidir.

Anahtar Kelimeler: Arıcı, ormancılık, bal üretimi, sosyo-ekonomik

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1. Introduction

Pollination is vital to our ecosystems, to human societies and beyond any doubt for life on our planet (IPBES, 2016; Potts et al., 2016; FAO, 2018). The health and well-being of pollinating insects are crucial to life, be it in sustaining natural habitats or contributing to local and global economies (Kluser et al., 2010). The most recent estimate of the global economic benefit of pollination amounts to some 265 billion € (Tirado et al., 2013). In fact, close to 75% of the world's crops producing fruits and seeds for human consumption depend, at least in part, on pollinators for sustained production, yield, and quality. The volume of agricultural production dependent on pollinators has increased by 300% in the last 50 years (FAO, 2018). Globally, nearly 90 percent of wild flowering plant species depend, at least in part, on the transfer of pollen by animals (Potts et al., 2016).

The vast majority of pollinator species are wild, including more than 20.000 species of bees, some species of flies, butterflies, moths, wasps, beetles, thrips, birds, bats, and other vertebrates (Potts et al., 2016). Almost 90% of wild plants are dependent on insect pollination, making bees indispensable pollinators in most ecosystems (Potts et al., 2010; Kopec and Lori, 2017; FAO, 2019). Bees – including both managed and wild species − are the world's primary pollinators. Habitat loss is a threat risk for bees as a result of agriculture intensification (e.g., changes in agricultural practices including the use of pesticides and fertilizers), urban development, increased frequency of fires, and climate change (Nieto et al., 2014). Bees can, in a sense, be considered as livestock. With the increasing commercial value of honey, bees are becoming a growing generator of income, livelihood strategy and means of food security for many small-scale producers and forest dwellers in many developing countries (IPBES, 2016; Kidu et al., 2017; FAO, 2018). Beekeepers, like other agricultural producers, have to deal with production and market challenges. Disruption of bees' natural habitats due to outbreaks of animal diseases, exposure to chemicals, loss of plant diversity, adverse climatic conditions, or natural or human factors can threaten the production capacity of beehives (Rossi, 2018).

Although, honey and the other products obtained from bees have been known by societies. Awareness of the role of bees in the maintenance of both forests and forest-dependent livelihoods is low. (Bradbear, 2009). Overall, 9.2% of bees are considered threatened in all of Europe, while at the European Union (EU-27) level, 9.1% are threatened with extinction. More than 5.2% of bees in Europe and 5.4% in the EU 27 are endangered (101 species at both levels) (Tirado et al., 2013). Regarding the distribution of endemic species, southern Europe shows the highest concentration of endemism. The largest numbers of threatened species are located in south-central Europe and the pattern of distribution of Data Deficient species is primarily concentrated in the Mediterranean region (Kluser et al., 2010).

Turkey is hosting 75% of the honey-producing plant species in the World (OGM, 2013). Turkey with at least five species is a bridging country connecting Europe, Middle East and Asia and also the center of western Honeybee (*Apis mellifera*) (Çakmak and Çakmak, 2016). More than a hundred thousand families have their own bee colony in Turkey and only 10% of them use beekeeping as an income source while 30% use an additional source of income. The remaining majority of them are engaged in hobby-type beekeeping activities (OGM, 2019).

In Turkey, forests make an important contribution to poverty alleviation, socio-economic development, and food security and they also help to secure a healthy environment, regardless of their types and their management framework (Erbas et al., 2015). Although beekeeping is classified as an agricultural activity, it is mainly done within or adjacent to forest areas in Turkey. It is seen that 85% of the total honey production is obtained from forests. Approximately 25% of the honey that produced is pine honey. In addition, many honey types such as chestnut honey, linden honey, acacia honey, rhododendron honey, thyme honey are also produced in forests (Altunel and Olmez, 2019).

There are also "Forest Villages Development Plans" targeting socio-economic developments of forest villagers. As of 2019, the amount of beekeeping loans given to 312 households is 914,849 USD (OGM, 2020a). In the Eleventh Development Plan (2019-2023) Forestry and Forest Products Working Group Report; Beekeeping is among the economical projects. With these projects, it is aimed to bring forest villagers together with new agricultural practices, improve their income level, contribute to employment, prevent migration from rural areas to cities and reduce the pressure on the forest. For the targets that are projected in the development plans, two Honey Forest Action Plans covering the years 2013-2017 and 2018-2023 have been prepared and implemented by the Ministry of Agriculture and Forestry. Within the scope of these action plans, it is aimed to increase the current number of 424 honey forests to 720 by 2023.

In this study, socio-economic factors affecting the adoption of improved beehives to increase honey production as well as the current beekeeping conditions in Ordu province with the highest honey production were revealed.

2. Materials and Methods

Turkey is among the top three countries in terms of both honey production-holds second place in honey production with 115 thousand tonnes after China in the World (Semerci, 2017) and 8 million hives existence (Table 1) (TKDK, 2016; TÜİK, 2020).

2.1 Study area

The study was conducted in Ordu province with the highest honey production in Turkey by considering four different districts randomly selected: Gölköy, Ulubey, Altınordu, and Kabataş. (Fig.1)

Table 1. Beekeeping in Turkey

Year	Number of villages in beekeeping	Number of beekeeping enterprises	New hives (quantity)	Old hives (quantity)	Honey production (tons)	Beeswax (tons)
1991	21,540	-	3,161,583	266,859	54,655	2,863
1992	21,931	-	3,289,672	250,656	60,318	2,916
1993	21,975	-	3,450,755	234,692	59,207	3,110
1994	22,050	-	3,567,352	219,236	54,908	3,353
1995	21,987	-	3,701,444	214,594	68,620	3,735
1996	22,329	-	3,747,578	217,140	62,950	3,235
1997	22,145	-	3,798,200	204,102	63,319	3,751
1998	22,302	-	4,005,369	193,982	67,490	3,324
1999	22,447	-	4,135,781	185,915	67,259	4,073
2000	22,571	-	4,067,514	199,609	61,091	4,527
2001	22,606	-	3,931,301	184,052	60,190	3,174
2002	22,423	-	3,980,660	180,232	74,554	3,448
2003	22,110	-	4,098,315	190,538	69,540	3,130
2004	22,133	-	4,237,065	162,660	73,929	3,471
2005	22,550	-	4,432,954	157,059	82,336	4,178
2006	22,305	-	4,704,733	146,950	83,842	3,484
2007	21,560	-	4,690,278	135,318	73,935	3,837
2008	21,093	-	4,750,998	137,963	81,364	4,539
2009	21,469	-	5,210,481	128,743	82,003	4,385
2010	20,845	-	5,465,669	137,000	81,115	4,148
2011	21,131	-	5,862,312	149,020	94,245	4,235
2012	21,307	-	6,191,232	156,777	89,162	4,222
2013	-	79,934	6,458,083	183,265	94,694	4,241
2014	-	81,108	6,888,907	193,825	103,25	4,053
2015	-	83,475	7,525,652	222,635	108,128	4,756
2016	-	84,047	7,679,482	220,882	105,727	4,440
2017	-	83,210	7,796,666	194,406	114,471	4,488
2018	-	81,830	7,904,502	203,922	107,920	3,987

The number of villages in beekeeping have been revised as “number of agricultural holdings in beekeeping” since 2013. Sources: TÜİK 2020.

The main livelihood of Ordu province is agriculture. The agricultural sector has an important place in the economic structure of Ordu with a share of approximately 85%. 38% of the province's land is agriculture, 30% is forest, 7% is meadow-pasture, 25% is a residential area and non-agricultural land. In 71.5% of agricultural enterprises in the province, animal husbandry is carried out together with crop production, while in 28.5%, only crop production is made (DKMP, 2012). Hazelnut production is the primary source of income which has approximately 40% of the whole production in Turkey. Beekeeping is also the most income-generating agricultural activity after hazelnuts.

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Fig. 1. Map of the study area (URL)

Table 2. Forest land situation of Ordu province

Total land (ha)	Total forest land (ha)	Productive forest (ha)	Nonproductive forest (ha)
587,114	202,896	170,308	32,588

Source: OGM (2020b)

There are honey forests that have been established in Ordu province. However, in interviews, it has been learned that these areas are not actively used. Table 3 provides information on the honey forests in Ordu province.

Table 3. List of honey forest in Ordu province

Province	District	Village	Name of Honey Forest	Area (ha)	Establishment year
Ordu	Gölköy	Düzyayla	Dibektaşı	72	2012
Ordu	Mesudiye	Gülpınar	Gülpınar	30	2010
Ordu	Gürgentepe	Bektaş	Gürgentepe	30	2013
Ordu	Gölköy	Damarlı	Ulubey-Gölköy	74.4	2012
Ordu			Kuzköy	37.2	2015
Ordu	Mesudiye	Pınarlı	Sarıçiçek	104.1	2016
Ordu			Konacık	169.7	2017

Source: OGM (2020b)

The list of important plants for honey production in Ordu province is as follows (OGM, 2019); *Castanea sativa* Miller; Cistus sp; *Epilobium angustifolium* L.; *Hedera helix* L.; *Laurocerasus officinalis* Roemer; *Ligustrumvulgare* L.; *Phlomis russeliana* (Sims) Beanthan; *Rhododendron ponticum* L. subsp. *ponticum* L.; *Solidago virgaurea* L. subsp. *alpestris Gaudin*; *Solidago virgaurea* L. subsp. *VirgaureaL. VacciniummyrtillusL.*;*Aesculushippocastanatum*; *Anthemis tinctoria* L.; *Astragalus* L.; *Centaurea solstitialis* L.,; *Centaurea triumfettii* All.,; *Duacus carota* L.; *Echium italicum* L.; *Eleagnus angustifolia* L.; *Lamium amplexicaule* L.; *Lythrum salicaria* L.; *Medicago sativa* L; *Morus alba* L.; *Phlomis pungens* Willd.; *Prunus amygdalus*; *Rosa canina* L.; *Salix* sp.; *Salvia* sp.; *Taraxacum officinale*; *Vicia sativa* L.; *Teucriumpolium* L.; *Xeranthemum annuum* L.

The study area was purposively selected because it is famous for beekeeping and honey production. In Table 4, the number of old and new hives, honey and beeswax production amount of the five prominent provinces as of 2019 are given (OTB, 2020).

Table 4. Top five provinces for beekeeping in Turkey

Province	Number of beekeeping enterprises	New hives (quantity)	Old hives (quantity)	Honey production (tons)	Beeswax (tons)
Ordu	2,636	573,268	90	17,057	120
Muğla	4,745	915,393	2,723	14,688	347
Adana	2,279	466,382	3,556	11,077	508
Sivas	2,985	242,728	945	5,029	419
Aydın	1,779	274,183	643	3,693	115

Beekeeping is done with a total of 573,268 hives in 2,636 enterprises, and 17,057 tons of honey and 120 tons of wax are obtained from this activity in Ordu. In this case the Ordu province ranks first in terms of provincial honey production in Turkey.

2.2 Data collection

The sampling frame was members of beekeeping cooperatives that were reached in 4 districts' villages within the Ordu province. Under normal conditions, it is planned to conduct a survey with 132 participants according to the sample size calculation among 3,000 members of the beekeeping cooperative. However, with the start of the pandemic process, there was only a chance to conduct a survey with about half the number of 132 members predicted (Table 5).

Collection of primary data rested mainly on a detailed three-pages of questionnaire, which included sections on members' demographics and information about beekeeping such as the reason for starting beekeeping, time to deal with beekeeping activity, types and number of hives (log or box), honeybee colonies holding size, amount of product obtained and method of use, to whom the products are sold. Finally, the effects of forests on beekeeping and thoughts about honey forests. The survey was conducted in the period of February-March 2020. Besides that, secondary data were obtained through relevant government agencies and literature reviews.

A great majority of questions were semi-structured, and the rest were open-ended. The questionnaire was conducted to the participants through face-to-face interviews by the researchers. The purpose of the questionnaire was to determine the beekeeping conditions in the study area as well as whether beekeeping has special importance in the livelihood conditions of the people and to provide information about the prudential planning on beekeeping among these people.

Table 5. Number of participants interviewed by the district

District	Number of participants
Gölköy	22
Ulubey	11
Altınordu	17
Kabataş	10

2.3 Data analysis

The data collected were coded and entered into SPSS version 16.0 for analysis. Descriptive statistics were generated for socio-demographic characteristics of beekeepers and the number of hive types and honeybee colony holding size and the logistic regression model was used to predict the factors influencing the adoption of improved beehives. As Hussain et al. stated, the logistic regression model has been used in various socioeconomic studies. Adam and El Tayeb (2014), Baiyegunhi et al. (2016), Jain and Sajjad (2016), Lepetu et al. (2009), Masozera and Alavalapati (2004), Tieguhong and Nkamgnia (2012), (Hussain et al. 2019) used a logistic regression model to analyze the impacts of demographic and economic variables.

3.Results

3.1 Socio-economic profiles of participants

Participants were selected from villages in 4 different districts by members of the beekeeping cooperative. All the beekeepers were males. The average age of beekeepers was 60.72 years with the majority (65%) between 36 to 64 years old. There was only one beekeeper under 40 years old. Moreover, 58.3% of the beekeepers have more than 30 years of experience, and 28.3% have a range of 20-30 years of experience in beekeeping. The average household size of interviewed beekeepers was 5.70 (Table 6). This average household size is larger than Turkey's average household size data in 2019 with 3.35.

Table 6. Socio-demographic characteristics of beekeepers

Variable	Items	M (SD)	%
Gender	Male		100
	Female		-
Age (years)	≤ 35		-
	36-64	60.72 (7.746)	65
	≥65		35
Education	Primary		46.7
	Secondary		51.7
	Tertiary		1.7
Formal training	Yes		98.3
	No		1.7
Experience in beekeeping (Years)	< 20		13.33
	20-30	30.97 (10.06)	28.33
	>30		58.33
Household size		5.70 (1.47)	
Type of beehives used	Traditional	151.67 (60.301)	
	Box	29 (15.233)	

M: Mean, SD: Standard deviation

3.2 Type and number of beehives and honeybee colonies holding size

Beekeepers reported that both traditional and box hive types were used for honey production. However, there is a greater preference for using traditional hives with rate of 100%. On the other hand, box hives were also preferred with a rate of 93% by beekeepers. Considering the average number of traditional and box hives it is seen that beekeepers mostly use traditional hives (Table 7). According to Table 7, while the traditional hive owned size of the beekeepers ranges from 50 to 300, with a mean of 151.67; the box hive owned size of beekeepers ranges from 0 to 100 with a mean of 29. Also, the average honeybee colony holding size of the beekeepers ranges from 50 to 350, with a mean of 154.17.

3.3 Factors influencing the adoption of improved beehives

The role of some socio-economic profiles in the acceptance of box hives by beekeepers has been evaluated using logistic regression. Age, education level, experience in beekeeping and household size variables were used to explain the determination of the adoption of box hives. In the study, the relationship between the dependent variable "adoption of box hive" and explanatory variables such as age, education level, training, experience in beekeeping and household size were measured.

Table 7. Number of hive types and honeybee colony holding size

Traditional hive owned			Box hive owned			Average honeybee colonies		
Min	Max.	Mean	Min	Max.	Mean	Min.	Max.	Mean
50	300	151.67	0	100	29	50	350	154.17

Our model as a whole explained between 18% (Cox and Snell R^2) and 37% (Nagelkerke R^2) of the variance in the adoption of box hives. The analysis indicates that 96% of beekeepers using low box hive use and 16.7% of beekeepers using high box hives were correctly estimated. The model made an accurate estimate of 88%. Table 8 shows the logistic regression coefficient, Wald test, significance, and odds ratio for each of the predictors using the 0.05 criterion of statistical significance. Only the age variable has significant partial effects in predicting the adoption of box hives ($p = 0.047$). But education ($p = 0.920$), household size ($p = 0.681$), experience ($p = 0.119$) did not add significantly to the model. The age of beekeepers had a negative influence on the adoption of box hives. According to Table 8, because the age coefficient is negative, the probabilities of reporting high adoption of box hives decreased with age (OR=0.75). This value represents a decrease in the adoption of box hives by a factor of 0.75 through the increase in the beekeeper's age, all other factors are equal.

Table 8. Logistic regression predicts the decisions of the factors that influence the adoption of box hives

Predictor	B	Wald	Sig.	Exp(B)	95% CI for Exp(B)	
					Lower	Upper
Age	-0.286	3.941	0.047	0.751	0.566	0.996
Education		0.497	0.920			
education(1)	20.846	0.000	1.000	1130199294.136	0.000	-
education(2)	19.943	0.000	1.000	458393731.418	0.000	-
education(3)	1.288	0.000	1.000	3.624	0.000	-
Household size	0.184	0.169	0.681	1.202	0.499	2.896
Experience	0.246	2.435	0.119	1.279	0.939	1.741
Constant	-14.467	0.000	1.000	0.000		

4. Discussion

From the perspective of the socio-economic profiles of the participants in terms of gender, there are studies with similar results that men are dominant in beekeeping (Mmasa, 2007; Okoye and Agwu, 2008; Kalanzi et al., 2015; Lunyamadzo, 2016; Minja and Nkumilwa, 2016; Mwakatobe et al., 2016).

It is seen that the young population has little proportionality to beekeeping. Migration from the village to the city due to job opportunities has a great effect on this situation. Also, the age distribution of beekeepers is generally within the active working-age group of 15-64 years old. These results regarding the age of beekeepers contrast with Okoye and Agwu (2008). Because, according to Okoye and Agwu (2008), the average age of beekeepers is 41 years old. In addition, the participation of young people in activities related to beekeeping is quite high.

Education levels of beekeepers are predominantly at primary and secondary education levels, due to the small population of young beekeepers. This result is similar with that provided by Lunyamadzo (2016) and Uisso et al. (2018). Almost all of the beekeepers stated that they received formal training. This finding shows that beekeeping is done consciously in the study area. On the contrary, ıt is pointed out by Kebede and Lemma (2007) almost all beekeepers (98%) and Shenkute et al. (2012) almost half of the respondents interviewed that had been never participated in any training on beekeeping. All the beekeepers stated that they used traditional hives while 93% also said they used box hives. Kebede and Lemma (2007) and Lunyamadzo (2016) also reported that almost all beekeepers had traditional hives in their study area.

When reviewing the comments made by looking at similar studies to explain using traditional hives, it can be said that it is similar to the results of our study. Beekeepers that use traditional hives lack benefits such as higher honey yield, easier colony control, and harvesting (Kalanzi et al., 2015). When the opinions of the beekeepers interviewed in the study area regarding the use of box hives were taken, they stated that they continued to use natural hives for the following reasons. Box hives are not preferred because the hives are cold for the bees and dampness is high. Therefore, bee yield decreases and disease increases, so natural hives which are more suitable for increasing yield and protecting bee health are used by beekeepers. This assessment is similar to the opinion of Getachew et al. (2015) that box hives may not be suitable for local bees. Kebede and Lemma (2007) also stated that the use of traditional beehives is widespread in the study areas for reasons such for being cheaper and requiring less accessories. There are also studies with opinions contrary to this situation. In these studies, it was stated that the improved beehives had higher annual honey production compared to traditional hives (Abebe et al., 2008; Getachew et al., 2015).

The age of beekeepers has a negative influence on the adoption of box hives. Getachew et al. (2015) also found the same relationship between age and the use of box hives in their study. Education also is one of the explanatory variables for explaining to determining the adoption of box hives. There are studies that acknowledge that education encourages the adoption of new technologies and as a result, educated farmers are more likely to adopt beekeeping (Ahikiriza, 2016). This finding is not the same for beekeepers involved in the study. Because it was seen that majority of the participants' education level was primary or secondary. In other words, although their

education level was low the beekeepers who participated in the study were very conscious about beekeeping

5. Conclusion

In today's modern market economy, multi-purpose and sustainable use and protection of forests are becoming more important (Martynova et al., 2020). As for beekeeping, it is important to take care to protect plants suitable for beekeeping in forestry activities. In addition, it is also important to consider the participation of species suitable for the mixture in afforestation and rehabilitation studies in beekeeping regions and to give priority to species useful for beekeeping in seedling production (KB, 2017). Raising awareness of the local people about the importance of honey forests through the relevant institutions will also contribute to the development of beekeeping.

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