

An Analysis on Migratory Beekeeping in Inner-West Anatolia Region, Afyonkarahisar, Turkey: Production, Practice, Marketing, and Challenges

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Abstract: This study aimed to analyze the challenges of migratory beekeeping enterprises related to their production capacity, beekeeping practices and, marketing in Afyonkarahisar. Some observations, measurements, and apiary land-based assessments were made in a total of 84 beekeeping enterprises that have been selected randomly with a stratified sampling method. Data from face-to-face interviews with beekeepers and production records on the farms were used via a semi-structured form. While there was a traditional honey production model in these enterprises, the average hive capacity was 323.98 units. It is determined that the average honey production per hive was 14.28 kg and, there was an increasing trend in production parallel to enterprise capacity. All enterprises have Muğla and Muğla x Anatolian hybrid bee colonies. Beekeepers reported that the most critical colony losses were originated from Nosema and Varroa infections, and most of the hives evaluated were more or less dirty and worn. It has revealed that there was no record kept of any bee health and production in many enterprises, and there was no plan for natural disasters in many apiary areas for emergencies. It has been concluded that honey yield increased with the enterprise size, the hives were dense in the apiary land, the amount of dirty and worn hives was high, and the major problems were related to bee transportation, shelter, marketing, and bee diseases.

Keywords: Afyonkarahisar, Challenges, Marketing, Migratory beekeeping, Production, Turkey.

İç-Batı Anadolu Bölgesi, Afyonkarahisar, Türkiye'de Göçmen Arıcılık Üzerine Bir Analiz: Üretim, Uygulamalar, Pazarlama ve Zorluklar

Özet: Bu çalışmada, Afyonkarahisar'da faaliyet gösteren gezginci arıcılık işletmelerinin üretim kapasitesi, arıcılık ve pazarlama uygulamaları ile karşılaştıkları zorlukların analiz edilmesi amaçlanmıştır. Afyonkarahisar'da bulunan arıcılık işletmelerinin coğrafi dağılımı dikkate alınarak tabakalı örnekleme yapılan ve rastgele seçilen toplam 84 arıcılık işletmesine ait arılıklarda inceleme, gözlem, ölçüm ve değerlendirme yapılmıştır. Arıcılar ile yapılan yüz yüze görüşmeler ve işletme kayıtlarından elde edilen veriler yarı yapılandırılmış bir form ile kayıt altına alınmıştır. Bu işletmelerde geleneksel bal üretilmekte olup ortalama kovan kapasitesi 323,98 adettir. Ortalama 14,28 kg olan kovan başına bal üretiminin işletme büyüklüğü arttıkça arttığı tespit edilmiştir. Tüm işletmelerde Muğla ve Muğla x Anadolu melezi bal arıları bulunmaktadır. Arıcılar koloni kayıplarının en fazla Nosema ve Varroa kaynaklı olduğunu bildirmiştir ve kovanların yaklaşık üçte birinin kirli ve yıpranmış olduğunu belirlenmiştir. Birçok işletmede üretim verileri ve arı sağlığına ilişkin kayıtların tutulmadığı ve arılık alanlarında doğal afetlere karşı acil durum planının bulunmadığı tespit edilmiştir. İşletme büyüklüğü ile bal veriminin arttığı, arılıktaki kovanların sıkışık bulunduğu, kirli ve yıpranmış kovan miktarının fazla olduğu ve önemli sorunların arı taşıma, konaklama, pazarlama ve arı hastalıklarına ilişkin olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: Afyonkarahisar, Gezginci arıcılık, Pazarlama, Türkiye, Üretim, Zorluklar.

Introduction

The extract and pollens taken from plants and flowers are processed by the bees and turned into valuable products such as honey, propolis, bee swarm, and beeswax. Beekeeping provides many benefits that have not been fully discovered yet, such as the support it provides to gastronomy, tourism, apitherapy and ecosystem health (Bozkurt 2019; Onbaşı et al., 2019; Şahingöz and İnci, 2018). In 2019, 1.852.598 tons of honey were produced globally, and 109.330 tons of honey were produced in Turkey, and, in 2020, 1.031 tons of honey were

produced with 57.836 hives in 316 enterprises Afyonkarahisar (Anonymous, 2021).

Afyonkarahisar, located in the Inner Western Anatolia Region, has a rich flora with industrial plants such as poppy, pulses, sugar beet, various horticultural crops, and fruit production such as cherries, sour cherries, plums on a total agricultural area of 3.503.724 decares and honey forests and pastures (Anonymous, 2001a). Environmental pollution and the use of artificial fertilizers are also low in the province (Anonymous, 2020). Due to its

favorable vegetation, pollen, nectar potential, and beekeeping culture, Afyonkarahisar is also an essential destination in spring for pine honey producers who want to strengthen their colonies and make a good start (Karahana et al., 2019).

The contribution of migratory beekeeping in total honey production in Turkey is significant (GEKA, 2019; Topal et al., 2019;). However, beekeepers face many problems in the migration the route they follow, such as inadequate floral capacity, a high number of beekeepers staying in the same area, accommodation permits, hive transport, and risks for bee health (Karahana et al., 2019; Şeker et al., 2017). More research is needed on the capacity, production performance, bee transport, bee and equipment characteristics, and bee management practices of migratory beekeeping enterprises to create a primary data set for local and national strategies. New scientific researches are also needed to solve these problems (Topal et al., 2016; Uzundumlu et al., 2011). So, this study was carried out to analyze the production capacity, beekeeping practices, and marketing problems of migratory beekeeping enterprises in Afyonkarahisar.

Materials and Methods

Methods for sampling, data collection, and apiary land assessment: The population of this research consists of 1915 migratory Beekeeping enterprises operating in Afyonkarahisar province. In the study, the sample was taken due to constraints such as time, cost, and distance. In this regard, the enterprises were determined by the stratified sampling method considering the density regarding the geographical distribution of migratory beekeeping enterprises in Afyonkarahisar (Ural and Kılıç, 2013). The formula suggested by Sekaran (2003) for quantitative research was used in determining the sample size. The formula is given below;

$$n = \frac{N \cdot P \cdot Q \cdot Z_{\alpha}^2}{(N-1) \cdot d^2 + P \cdot Q \cdot Z_{\alpha}^2}$$

From the parameters in the formula, N=1915, P=50%, Q=50%, the theoretical value corresponding to the significance level of 0.05 $Z_{\alpha}=1.96$, d=10% is taken, and the minimum sample size was calculated as 92. In this context, data were collected from 92 enterprises, and the data were judged to be complete and reliable from 84 businesses, and statistical analyses were made on this sample.

Data was formed by on-apiary land assessments, some measurements, and observations conducted in apiary lands and the information received from the beekeepers' face-to-face interviews and enterprise records. During the

apiary land visits, all the hives were counted (old, new, empty, or with a colony), honey bee ecotype, harvesting method, bee products, type, and number of vehicles used for bee transportation and beekeepers' travel routes were determined. The quality condition and cleanliness of the hives and beekeeping equipment were also evaluated. Moreover, hive bottom board height, the distances between hive rows, and between beehives positioned side by side on the same row were measured. Vegetation in terms of nectar and pollen sources on the surrounding land of apiaries were also observed and evaluated. The record kept in beekeeping enterprises related to diseases, treatments, preventive health measures, and production performance was examined. The beehives and honey yield ratio per hive were evaluated by grouping according to the enterprise-scale (1-50, 151-300, 301-450, and >451 hives in groups 1, 2, 3, 4, respectively). Information about bee temperament and aggressiveness, preventive practices for bee aggressiveness, colony care, queen bees, and marketing practices were obtained from beekeepers. In these interviews, information about ownerships of bee transport and travel vehicles, drivers, bee transport practices, ownership of apiaries, insurance of vehicles and hives and, residue and quality control tests in honey were also obtained. In addition, the information about bee diseases and pests observed in the enterprise and the precautions to support bee health were recorded. By using the records of beekeeping in enterprises, if there are any, or by using the data obtained from the beekeepers, if not, data on previous year's production of honey, pollen, beeswax and propolis, annual bee transport distance and fuel expense, and prices of bee products were collected. A semi-structured form has been developed for data collection and data recording processes. Institutional Animal Care and Use Committee has approved this study (Ref. No: AKUHADYEK-140-18).

Statistical Analysis: Descriptive statistics such as frequency, percentage distribution, arithmetic mean, and standard error were applied. Obtained data were analyzed using SPSS 18.0 for Windows (SPSS, Inc., Chicago).

Results

The results on the scale of the enterprise and honey bee temperament and the beekeeping practices such as queen bee management, hive inspection, bee care, and honey harvesting were given in Table 1. It was determined that the enterprises were registered in beekeeping registration system, and were members of Muğla

Beekeepers' Association (46.40%) and Afyonkarahisar Beekeepers' Association (53.60%).

Statistical results related to annual honey, pollen, beeswax, and propolis production levels in beekeeping enterprises were presented in Table 2. The ratios of beekeepers reported that they were producing honey, pollen, beeswax, and propolis were 100.0, 28.57, and 15.48%, respectively, and only 1.19% of beekeepers stated that they were producing royal jelly. It is determined that the number of beehives with a colony and honey yield showed an increasing trend along with enterprise capacity (Figure 1). The type and ownership of

transport vehicles, insurance details, marketing, and honey quality monitoring in the beekeeping enterprises were given in Table 3. Results were also presented related to producer prices and quality monitoring strategies for bee products, marketing channels, insurance, and honey quality monitoring. It has been revealed that 69.00% of beekeepers used bank loans to cover their operating costs, and 22.60% of those were benefited from beekeeping grant support. The study determined that beekeeping was carried out in an average of 3.13 different apiary locations during the honey season, which lasted for an average of 258.04 days.

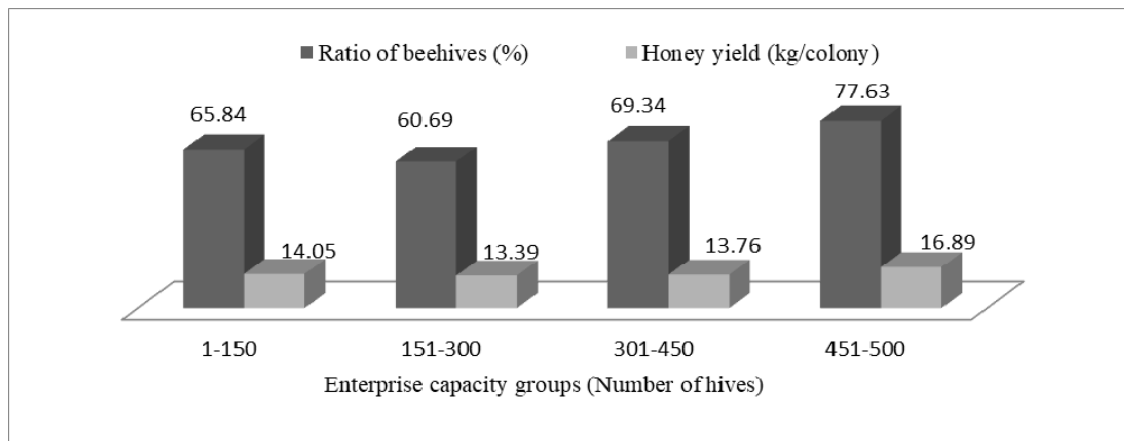


Figure 1. The ratios of beehives having a colony and honey yield per beehive by enterprise capacity groups.

The results of the apiary land-based assessment related to the traits of beehives, beekeeping equipment, and the apiary lands of the enterprises were given in Table 4. The annual losses related to bee diseases and pests, bee colony problems, cleaning and disinfection practices, and record-keeping in the enterprise were also given in the same table.

Discussion and Conclusion

The beekeeping establishments visited in Afyonkarahisar city center and its districts were all the members of Afyonkarahisar and Muğla Beekeepers' Union and were engaged in migratory beekeeping. The average hive capacity of beekeeping enterprises was 323.98, and 51.19% have more than 301 hives. In other words, these enterprises were medium and large-sized (GEKA 2019) and migratory beekeeping enterprises (Karaca and Özince, 2019). These average enterprises capacity was higher than the values of Öztürk (2017) for Muğla (average of 258 hives) and of Karahan (2019) for Afyonkarahisar (32% in the group of >201 hives). Bee aggression reported by beekeepers is undesirable bee behavior. This

aggression maybe related to the genotypic weight of the Muğla bee in the honey bee colonies because Akyol et al. (2003) determined that the Muğla queen bee colonies and their hybrids were more aggressive than the other. About this issue, some beekeepers apply some preventive measures such as collapsing and narrowing of the hive entrance, manipulating the feeding time (Doğaroğlu, 2009), and changing the location of the hives on the apiary land. It is thought that bee aggression in this study may arise from the hive location in apiary land (the distance between hives and rows was 19.26 cm and 5.30 m, respectively). As supporting these results, Forfert et al. (2015) reported a relationship between inter-hive distance at the apiary land and drifting of workers.

According to beekeepers and production records, the average honey yield of the enterprises per hive was calculated as 14.28 kg. This level of productivity was close to the Turkey average (14.36 kg) but lower than the world average (20.10 kg) (Anonymous, 2020; Anonymous, 2021). However, this productivity was similar with the values (13.44 kg-19.27 kg) reported for the Aegean region (Paksoy et al., 2016; Onuç et al., 2019; Özbilgin et al., 1999), while higher than the averages of 11-15 kg reported

Table 1. The results related to hive capacity, honey bee traits. and the practices related to bee feeding and honey harvesting.

Factors	Variables	Results
Enterprise	Number of new hives	317.02 ± 18.92
Capacity	Numer of empty hives	96.87±9.36
	Number of beehives	220.15±17.18
	Number of damaged and worn-out hives	6.96±4.44
	Number of empty hives	1.25±0.88
	Number of beehives	5.71±3.88
	Total number of beehives	225.87±17.12
	Total number of empty hives	98.12±9.60
	Ratio of beehives (%)	67.70 ±23.52
Honeybees	Ecotypes of honeybees	Mugla honey bees (Western Anatolia) (45.24%) Anatoliaca honey bees (Central anatolia) (3.57%) Caucasian honey bees (3.57%), Carniolan honeybees (1.19%) Italian honeybees (2.38%) Mugla x Anatoliaca cross Honey bees (38.10%) Caucasian x Carniolan cross Honey bees (3.57%) Italian x Carniolan Cross Honey bees (2.38%)
Bee Temperament	Honeybee colony personality	Calm (14.30%), aggressive (85.70%)
	Aggressiveness in collective foraging behavior	Aggression (83.33%), No aggression (16.67%)
	Preventive practices for bee aggressiveness	Narrowing the hive entrance (16.70%) Replacing the hives (46.30%) Manipulating the feeding time (11.90%) Reducing beekeeping visits (1.20%) No app is helpful (2.40%) Division or combine of colonies (3.60%) Replacement of the bee yard (1.20%)
Queen bee	Procurement of queen bee	Queens are produced on the enterprises (84.52%) Queens are purchased from queen bee enterprises in Muğla (4.77%), Antalya (3.57%), Hatay (1.19%), Artvin (3.57%), and Ankara (2.38%)
	Frequency of requeening	Once per year (8.30%), once per 2 years (88.10%), once per 3 years (3.60%)
Hive inspection frequency (montly)	Brood box	5.96±0.39
	Honey box	5.82±0.41
Winter honey bee feeding	Number of honeycombs used (number/hive)	2.98±0.16
	Number of bees in the colonies	42321.43± 967.21
Spring honey bee feeding	Amount of suger used for syrup feeding (kg/hive/year)	6.61± 0.37
Autumn honey bee feeding	Amount of suger used for syrup feeding(kg/hive/year)	3.10± 0.23
	Total of annual suger used for feeding(kg/hive/year)	9.82± 0.56
Harvesting honey	Harvesting season	Between August and October (100.0%)
	Harvesting time of day	8.00-17.00(96.40%); 10:00-14:00(2.40%) 09:00-13:00(1.20%)
Extracting honey	Harvesting method	Shake and brush (100.0%), Extraction devices
		Electric honey extractor (45.24%), Manual honey extractor (54.76%)

Table 2. The statics of on annual honey, pollen, beeswax, and propolis production in beekeeping enterprises.

Bee product	Honey		Pollen		Beeswax		Propolis	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Number of enterprises	84		24		13		6	
Ratio of enterprise	100.00		28.57		15.48		7.14	
Enterprise capacity (hives)	323.98	18.56	315.04	35.04	294.31	42.15	195.83	41.97
Ratio of beehives (%)	67.70	2.57	72.05	4.27	68.69	6.28	67.40	8.73
Number of beehives	220.17	15.49	212.87	30.76	240.62	38.80	129.67	20.77
Production (kg/year)	3169.93	78.72	331.58	99.21	115.77	20.16	2.91	0.66
Yield (kg/colony/year)	14.28	0.64	1.26	0.28	0.51	0.09	0.02	0.00
Honey season (days/year)	258.04	14.48	125.21	27.23	183.85	40.39	150.83	50.30
Number of apiary locations	3.13	0.16	2.42	0.37	3.08	0.56	2.67	0.95

Table 3. The results on bee transport, insurance, marketing, and honey quality monitoring in the beekeeping enterprises.

Factors	Variables	Results		
Transporting hives	Enterprise's own transport vehicle	Yes (35.71%), No (64.29%)		
	Type of own transport vehicle	Truck (1.19%), pickup (22.62%), tractor (11.90%)		
	Beehive transport with a rental car	All vehicles were rental (64.29%) Both of own and rental vehicles (4.76%) All vehicles belonged to the enterprise (30.95%)		
	Type of rental transport vehicles	Truck (69.05%)		
	Number of hives transported per truck	400.82±0.75		
	Number of hives transported per pick-up	119.09 ±11.19		
	Number of hives transported per tractor	136.40±2.35		
Driver	Drivers of transport vehicles	Beekeepers (100.0%)		
Vehicle's speed	Average speed by road type	Asphalt:87.56±0.49		
	(kilometers/hours)	Stabilized: 32.74±0.59		
Travel vehicles for beekeepers	Enterprise's travel vehicle	Yes (%77.38) No (22.62%)		
	Number of travel vehicle	One car (73.81%), 2 cars (3.57%)		
	Type of travel vehicle	Motorcycle (11.91%), Minibus (10.71%) Automobile (54.76%),		
Fuel expense	Annual fuel usage (liter)	1280.36±94.04		
	Annual distance (km)	5533.21±569.02		
Insurance	Vehicle insurance	No (100.0%)		
	Behive insurance	No (100.0%)		
Producer prices	Honey (TL)	30.56± 8.70		
	Pollen (TL)	48.96±5.75		
	Beewax (TL)	303.64±83.62		
Marketing	Marketing channel of bee products	Beekeeper to consumer (63.10%) Beekeeper to a wholesaler (21.43%) Both beekeeper and wholesalers (15.47%)		
		Wholesaler companies	Wholesaler companies in İstanbul (19.05%) Wholesaler companies in Muğla (10.71%) Wholesaler companies in İzmir (3.57%) Wholesaler companies in Aydın (3.57%)	
		Quality monitoring	Ingredients/residue tests in honey	Yes (10.71%), No (89.29%)
			Institutes that carry out the tests	Wholesaler companies laboratories (2.38%) Private laboratories (2.38%) laboratories Public institution (2.38%) University laboratories (3.57%)

Table 4. The results related to the traits of beehives and apiary lands, bee diseases, and the data recording and colony losses.

Factors	Variables	Results
Beehives	Type of hives	Longstroth hives with single honey super (100.00%)
	Materials of hives	Wooden (97.62%) Plastic (2.38%)
	Cleanness of hives	Clean (75.00%), slightly dirty (23.80%), very dirty (1.20%)
	Quality of hives	Solid (54.80%), slightly worn (9.50%), very worn (35.70%)
Beehives are arranged in a long line	Outer cover	Appropriate (100.0%)
	Height of hive stand from the ground (cm)	11.13±0.71
Beehive placement	Distance between the beehive rows (m)	5.30±0.22
	Distance between the beehives on a row (cm)	19.56 ±1.61
Beekeeping equipment	Cleannes of equipments	Clean (100.0%)
	Quality of equipments	Solid (60.70%), slightly worn (38.11%), very worn (1.19%)
Apiary land	Ownership of apiary	Private land (45.20%) Village land (32.20%) Land owned by other legal entities (22.60%)
	Apiary land assessment	adequate(94.00%), inadequate (6.00%)
	Nectar and pollen plants in the apiaries	Wild flowe (23.80%), Fruit trees (4.80%), Shrubs (8.30%), Wild flowe+ Fruit trees (4.80%), wild flower+ Shrubs (4.80%), wild flower+ Fruit trees + Shrubs (53.50%)
Bee health	Bee diseases	Occurred (45.24%), Not occurred (54.76%)
	Bee diseases	Nosema (38.10%) Chalkbrood disease (2.38%), American foulbrood disease (2.38%), Unrecognized disease (2.38%)
	Bee pests	Occurred (92.86%), not Occurred (7.14%)
	Bee pests	Varroa (92.86%), Bee-eater (9.52%) Wasp (3.57%), Ant (2.38%) Bear (2.38%), Hedgehog (1.19%)
Struggling with diseases	Bee health protection measures	Applying (100.0%)
	Post-harvest pesticide control	Both for Varroa and Nosema (28.57%) For Varroa (45.23%), for Nosema (4.76%) For Lime Disease (1.19%) Only cleaning/disinfection (7.14%)
Losses	Hives and colonies	Yes (11.90%), No (88.10%)
	Disposal methods of infected hives and colonies	By burning (2.38%), by burying (9.52%)
	Eradication methods	Cleaning +disinfection (10.71%) Burning and scraping (51.19%) Burning + scraping + bleach (28.58%) Incineration + cleaning with water (4.76%) Burning + scraping + thyme or pollen solution (4.76%)
Recording data	Recording enterprises's data	Yes (51.19), No (%48.81)
	Records kept	Production + bee diseases + treatment (28.58%) Bee diseases + treatment (10.71%) Production (11.90%)

for North East Anatolian Region (Sezgin and Kara, 2011). The variation between these reports may be due to several environmental factors affecting honey production. It is seen that one of them was enterprise capacity. Indeed, this study has determined that the more sizes of the bee enterprises increase, the more honey yield per hive increases, and that honey yield reached 16.89 kg/hive in enterprises with >451 hives. These findings showed that medium and large-scale enterprises were more effective in beekeeping (Figure 1) and have more nectar and pollen flow by staying longer time at different apiaries (Özbakır et al., 2016; Öztürk, 2013). Uzundumlu et al. (2011) reported similar findings in Bingöl, but Üçeş and Erişir (2016) reported that small-scale enterprises businesses were more common in Erzincan. These results were also consistent with the importance of good queen bee and colony management. Because beekeepers reported that they raised the queen themselves (84.52%), changed the queen at most two-year-long periods (96.4%), and made hive checks on average six times a month. Previously, it reported that strong colonies with young and healthy queens and good bee care and optimum feeding practices for the winter, spring, and summer seasons support honey production and other honey products (Doğaroğlu, 2009; Şeker et al., 2017).

In 28.57, 15.48, and 7.14% of beekeeping enterprises, the beekeepers reported production as 1.26 kg of pollen, 0.51 kg of beeswax, and 0.02 kg of propolis per hive, respectively. The results obtained in terms of honey and pollen production per hive were in line with the reports of Alataş et al. (1997) (Honey is 35-44 kg/hive, and dry pollen is 1.56 kg/hive). It is determined that 63.10% of the enterprises sold honey by retail and 21.43% through wholesalers, the average honey price calculated as 30.56 TL/kg. This value was lower than TURKSTAT 's suggested honey retail price (46.45 TL/kg) in December 2020 (Anonymous, 2021). According to the marketing results realized in the enterprises, it is determined that the average prices of pollen and beeswax were 48.96 and 303.64 TL. In addition, only 10.71% of beekeepers reported that they purchased testing services for residue and quality control in honey (Anonymous, 2021).

It has revealed that two-thirds of the enterprises transported beehives via transport vehicles (trucks, trucks, pick-up trucks, or tractors) used for general purposes in the transport sector; only the remaining one-third have their transport vehicles. Accordingly, it is understood that these transport vehicles do not have the particular

standards required to protect bee health and welfare during transport. These findings suggested that both beehives could be damaged during transport, and bee health and welfare could be adversely affected. In enterprises, it is determined that all of the beehive transport vehicles were driven by the beekeepers, and the average vehicle speed was determined to be 87.56 km/h on the asphalt roads and 32.74 km/h on the stabilized roads. The fact that only 77.38% of the enterprises have travel cars (mainly automobiles) points to other difficulties related to travel and an accommodation that beekeepers face. Beekeepers have traveled an average of 5533.21 km (3 to 7 apiary areas) annually with these vehicles but did not have vehicle or hive insurance. These results could be attributed to financial problems in bee enterprises. Contrary to the statement of Onuç et al. (2019) for beekeepers in İzmir, 69.0% of beekeepers benefited from loan support for business financing, and only 22.60% of those benefited from beekeeping grant support.

Half of the beekeepers reported colony losses due to bee diseases and, almost all of them for Varroa. It was understood that the bee population in a hive before winter was 42321.43 on average and bee losses were high in the winter season. Results were parallel to other reports (Karahan et al., 2019; Özbakır et al., 2016; Şeker et al., 2017). Moreover, 12% of the enterprises' infected honey, hives, and colonies were destroyed and caused economic losses. Although beekeepers carried out cleaning, disinfection, and medical applications in their hives after harvesting, it is thought that bee losses were high. This contradictory result suggested that success in bee health protection and disease control in enterprises was still insufficient. Only 28.58% of the enterprises keep regular records on production, bee diseases, and treatments. In addition, the presence of dirty and warned-out hives also supported this result. It was observed that surveyed apiaries mainly belonged to actual persons and villagers (77.40%). It also observed that there was no emergency plan for natural disasters in any apiaries.

Consequently, it has been concluded that honey yield increased with the enterprise size, the hives were dense in the apiary land, the amount of dirty and worn hives were high, and the preventive measures against natural disasters were insufficient in migratory beekeeping enterprises. Also, it was understood that beekeepers have difficulties obtaining apiary land and in bee product marketing, and they cannot cope with bee diseases despite their protective practices such as disinfection.

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