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Determination of Beekeepers' Thoughts on Current Problems and Colony Losses

Determinación de la opinión de los apicultores sobre los problemas actuales y las pérdidas de colonias

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ABSTRACT

The aim of this article is to examine the current problems of beekeepers in Turkey and the effects of these problems on colony losses and to determine the thoughts and solution suggestions of beekeepers against this situation. The research was conducted with 412 beekeepers in Turkey between February and May 2024. In order to determine the beekeepers to be surveyed, a preliminary study was conducted with 50 beekeepers from different provinces. It was determined that 95.6% of the participants were male, 50.7% were in the 31-50 age range, the majority (87.6%) were married and 49.3% were university graduates (P<0.01). While 27.7% of the beekeepers purchased queen bees for their colonies commercially, 57.0% of them produced them themselves (P<0.01). High input costs were stated as the most important problem of Turkish beekeeping by 30.8%. The most common disease and pest encountered by beekeepers was Varroa destructor with 79.4% (P<0.01). As a result, this study reveals beekeepers' perspectives on current problems and colony losses and evaluates how a sustainable production can be made by addressing the main problems in the beekeeping sector. The study emphasises the necessity of policies and practices at local and national level for the sustainability of the beekeeping sector and the reduction of colony losses.

Key words: Honey bee; beekeeping problems; varroa destructor; disease

RESUMEN

El objetivo de este artículo es examinar los problemas actuales de los apicultores en Turquía y los efectos de estos problemas en las pérdidas de colonias, así como determinar las ideas y sugerencias de solución de los apicultores frente a esta situación. La investigación se llevó a cabo con 412 apicultores de Turquía entre febrero y mayo de 2024. Para determinar los apicultores a encuestar, se realizó un estudio preliminar con 50 apicultores de diferentes provincias. Se determinó que el 95,6% de los participantes eran hombres, el 50,7% tenían entre 31 y 50 años, la mayoría (87,6%) estaban casados y el 49,3% eran titulados universitarios (P<0,01). Mientras que el 27,7% de los apicultores compraban abejas reinas para sus colonias con fines comerciales, el 57,0% las producían ellos mismos (P<0,01). El 30,8% de los apicultores turcos declararon que el problema más importante de la apicultura turca era el elevado coste de los insumos. La enfermedad y plaga más común a la que se enfrentaron los apicultores fue Varroa destructor, con un 79,4% (P<0,01). Como resultado, este estudio revela las perspectivas de los apicultores sobre los problemas actuales y las pérdidas de colonias, y evalúa cómo puede lograrse una producción sostenible abordando los principales problemas del sector apícola. El estudio subraya la necesidad de políticas y prácticas a escala local y nacional para la sostenibilidad del sector apícola y la reducción de las pérdidas de colonias.

Palabras clave: Abeja melífera; problemas de apicultura; Varroa destructor; enfermedad

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INTRODUCTİON

Turkey has an important position in world beekeeping in terms of its wide geography, rich vegetation and racial diversity of honey bee (*Apis mellifera*) colonies. Beekeeping is a low-cost livestock breeding activity that provides financial contribution to producers and the national economy and does not require much labour force. The utilisation of natural resources in nature by honey bees is also of great importance for the sustainability of agricultural production [1 , 2]. The fact that there are four seasons in Turkey, that each region has its own pollen, nectar and plant flora and that flowering periods spread over different times provide advantages for itinerant beekeeping. In addition, the diversity of honey bee races and ecotypes that can adapt to different ecological conditions constitutes an important factor for Turkish beekeeping [3].

Honey bees live in highly organised colonies as social insects with a clear hierarchy. Beekeepers therefore need a good understanding of their behaviour and biology in order to manage their colonies effectively. A colony usually consists of a single queen, thousands of female worker bees and several hundred drones. The queen's job is to lay eggs, while the worker bees undertake various tasks such as nectar and pollen collection, brood care and hive defence. The drones mostly fulfil the mating function with the queen [4]. Most of the beekeepers in Turkey are engaged in itinerant beekeeping. Some other beekeepers prefer stationary beekeeping due to problems such as accommodation and security. It is of great importance to determine the problems of accommodation, low yield, origin of queen bees, lack of information on care and feeding, and marketing problems scientifically and to offer solutions for the producers who continue beekeeping as their main source of livelihood [5].

In beekeeping, training in the care and feeding of bees, queen breeding and breeding studies, harvesting and storage of honey, protection of bees and hives from parasites and diseases, branding and increasing product value are of great importance. Experience and utilisation of internet resources are among the important factors affecting productivity and income [6]. Although beekeeping activities are being carried out in a more professional manner, various developments that negatively affect production have been observed recently. The most important of these negativities is the increase in bee mortality and colony losses together with low productivity [7]. The causes of losses in bee colonies include many factors such as bee diseases, parasites, pesticide use, environmental factors and socioeconomic factors [8].

There are approximately 101 million honey bee colonies in the world. When we analyse the total number of colonies in the world on the basis of countries, India ranks first with a share of 12.5%, China ranks second with a share of 9.2% and Turkey ranks third with a share of 8.9%. In addition, a total of approximately 1.8 million tonnes of honey is produced from these colonies. In world honey production, China ranks first with a share of 25.2% (462 thousand tonnes) and Turkey ranks second with a share of 6.5% (118 thousand tonnes) [9]. Turkey has an important place in honey bee colony existence and honey production in the world. The natural conditions of the country make Turkey a strong actor in honey production and beekeeping activities contribute to the rural economy. Therefore, the development and support of beekeeping in Turkey is of great importance to increase both domestic supply and exports.

The aim of this article is to examine the current problems of beekeepers in Turkey and the effects of these problems on colony losses and to determine the thoughts of beekeepers about this situation and their solution suggestions.

MATERIAL AND METHODS

The research was carried out with 412 beekeepers in Turkey between February and May 2024. In order to determine the beekeepers to be surveyed, a preliminary study was conducted with 50 beekeepers from different provinces. Muğla, Ordu, Ankara, Adana, Adana, Sivas, Erzincan, Balıkesir and Şanlıurfa provinces from different regions were included in the study to represent the sample size. The beekeepers were reached through the Beekeepers Association and beekeeping equipment sales points. The beekeepers to be surveyed were randomly reached from different socioeconomic and educational levels of the society during their visits to these points. Among these people, face-to-face and/or online surveys were conducted with those who agreed to participate in the survey. The people who will work as surveyors in the study were informed about the purpose of the study, survey questions and study plan. For face-to-face surveys, participants were not allowed to answer the questionnaire more than once. In addition, in online surveys, brief information was given for the study and if the IP numbers sent through the system were the same, it was applied in a way to prevent repetition.

The data obtained from the answers given to these questionnaire questions constituted the research material. The respondents were asked 23 questions to determine the sociodemographic characteristics of beekeepers and their opinions on beekeeping problems and colony losses. The ethical approval required for the research was obtained from Erzincan Binali Yıldırım University Human Research Science and Engineering Sciences Ethics Committee in Turkey (decision dated 26.11.2023 and numbered 04/01). The questions used in the questionnaire were prepared by the research team by utilising similar questions from previous studies [10 , 11 , 12].

In the data obtained from the questionnaire study, descriptive statistics were created by calculating numerical and percentage (%) frequencies for each parameter. Chi-square test was applied for the comparisons of the answers given to the questions directed to the beekeepers regarding their preferences between the options. In the analyses, $p<0.05$ was taken as significance level [13]. Frequency calculations and Chi-square analyses were performed using SPSS 22.0 programme [14].

RESULTS AND DISCUSSION

The findings of this study reveal the main problems faced by beekeeping producers in Turkey and the effects of these problems on colony losses. The findings were evaluated based on the sociodemographic characteristics of the participants, their level of knowledge about beekeeping, the problems they face and their opinions about these problems. Sociodemographic characteristics of the beekeepers participating in the study were analysed with the help of descriptive statistics. The distribution of the participants according to gender, age, marital status, education level and number of people in the household is presented in TABLE I.

TABLE I.
Sociodemographic characteristics of beekeepers

Questions	Answers	Frequency	
		n	%
Gender	Female	18	4.4
	Male	394	95.6
P		**	
Age (Years)	18-30 years old	44	10.7
	31-50 years old	209	50.7
	51 years old and above	159	38.6
P		**	
Marital status	Married	361	87.6
	Single	51	12.4
P		**	
Educational status	Primary Education-Secondary Education	145	35.2
	Associate Degree-Undergraduate	203	49.3
	Postgraduate	64	15.5
P		**	
Number of people in the household	I live alone	18	4.4
	2 people	44	10.7
	3 people	84	20.4
	4 people and above	266	64.5
P		**	
Total		412	100

**:P<0.01

In the current study, it was found that 95.6% of the participants were male, 50.7% were in the 31-50 age range, the majority (87.6%) were married and 49.3% were university graduates. In addition, the study shows that most of the participants (64.5%) live in crowded households. These data obtained in the study form a general profile of the sociodemographic characteristics of beekeepers in Turkey and the differences between groups are significant (P<0.01).

In this study, it shows that men are in the majority (95.6%) in the beekeeping sector (P<0.01). Areas such as agriculture and animal husbandry are often seen as occupations associated with men. This is a departure from gender roles and traditional expectations. Socially ingrained ideas, such as the continued physical strength of men and the restriction of women to more domestic roles, may result in women being less interested in outdoor occupations such as beekeeping. In addition, women may have preferred it less because of the accommodation and safety issues in rural and itinerant beekeeping. The findings of this study are in line with Köseman *et al*. [10], Özbakır *et al*. [15], Üçeş and Erişir [16], Arslan [17], Aksoy *et al*. [18], Çevrimli [19], Burucu and Gülse Bal [20], Şeviş [21], Söğüt *et al*. [22], Karahan [23], Albayrak [24], Kaya [25] and Şengül [26].

When the age groups were analysed, it was determined that 50.7% of the participants were between 31-50 years old. This situation shows that beekeepers are mostly gathered in the middle age group (P<0.01). It was noteworthy that young individuals were the least (10.7%) among the beekeepers in the study. This indicates that beekeepers are considered by people as an occupational option, despite the high youth population in Turkey and the changing distribution of power ratios. Therefore, this profession should be encouraged in order to overcome the deficiencies in beekeeping, make it more attractive and rejuvenate it [10]. The findings of this study were consistent with the results of İnci *et al.* [27] were consistent with the results of. It was also determined that the majority of the participants (87.6%) were married (P<0.01).

When the educational level of the participants was analysed, it was determined that 49.3% of them had associate degree or bachelor's degree and 15.5% had postgraduate education. It was observed that more than half of the participants had higher education level (P<0.01). In modern beekeeping, there are not only the limits of basic operations such as hive maintenance and honey production. It also requires knowledge of production technologies, biology and ecology, diseases and pest control. Beekeepers with high level of education can access and apply such knowledge and techniques more easily. According to the findings of the present research, the proportion of beekeepers who graduated from higher education institutions is higher than those of Tunca and Çimrin [28], Köseman *et al.* [10], Karahan *et al.* [12]. This difference in the present study conducted throughout Turkey may be due to the fact that the other studies were conducted in local regions.

In the present study, when the distribution of the surveyed beekeepers according to the number of people in the household was analysed, 4.4% stated that they lived alone and 64.5% stated that they lived with four or more people. These results show that the respondents mostly live in crowded households (P<0.01). In beekeeping, crowded families have some important advantages. These advantages provide ease in performing various tasks such as labour availability, sustainability of the business, completion of hives, harvesting, product packaging, marketing and regular checks on the health of bees. In crowded families, these tasks can be done more quickly and efficiently, everyone undertakes a certain task and ensures the continuity of the work. In this study, the data on the number of households were analysed according to Köseman *et al.* [10] reported (70.5%) that there were four or more people living in the household.

In this section, the level of beekeepers' knowledge on bee husbandry, beekeeping activities and data on bee products were analysed. Various aspects such as the participants' years of experience, the way they consider beekeeping as a livelihood, number of hives, wintering methods, types of beekeeping, product marketing methods and sources of information were evaluated and the results of the study are presented in TABLE II.

TABLE II.
Beekeepers' knowledge about beekeeping

Questions	Answers	Frequency	
		n	%
How many years have you been doing beekeeping?	5 years or less	90	21.8
	6-15 years	140	34.0
	16 years or more	182	44.2
	P	**	
How often do you see beekeeping as a source of income?	Primary	94	22.8
	Secondary	213	51.7
	Tertiary	70	17.0
	My only source of income	35	8.5
	P	**	
Number of hives in your apiary	10 hives and less	73	17.7
	11-50 hives	118	28.6
	51 hives and more	221	53.7
	P	**	
Where do you winter your bees?	In the open area	379	92.0
	Indoors	33	8.0
	P	**	
What kind of beekeeping do you do?	Fixed	217	52.7
	Traveler	195	47.3
	P	*	
How do you market the bee products you produce?	Myself (Retail)	341	82.8
	Wholesale	71	17.2
	P	**	
Are you a member of the Beekeepers Association?	Yes	256	62.1
	No	156	37.9
	P	**	
	Total	412	100
What bee products do you produce?	Honey	412	49.6
	Pollen	236	28.4
	Propolis	138	16.6
	Bee bread (Perga)	26	3.2
	Royal jelly	18	2.2
	P	**	
	Total	830	100
How do you access information about beekeeping?	I do not receive information	42	5.1
	From books	145	17.6
	From ministry organizations	46	5.6
	From experienced beekeepers	276	33.5
	From the internet	223	27.1
	NGO (Beekeepers' association)	59	7.2
	Other	32	3.9
	P	**	
	Total	823	100

*:P>0.05, **:P<0.01

When the beekeeping experience of the participants was analysed, 44.2% of them have been beekeeping for 16 years or more, 34.0% for 6-15 years and 21.8% for 5 years or less. This finding shows that the beekeepers participating in the study were mostly experienced (P<0.01). Experience in beekeeping plays a critical role for a successful beekeeping enterprise. Issues such as the natural cycles of bees, their growth, reactions and hive management are better understood with the fine details learnt through experience. In previous studies, the average beekeeping experience period was 13.8 years by Demen [29], 20.8 years by Emir [30], 18.4 years by Keskin [31], 17.5 years by Çevrimli [19], 17.5 years by Çevrimli and Sakarya [32], 18 years by Şeviş [21], 18 years by Söğüt *et al*. [22] 18 years, Aktürk and Aydın [33] 19 years, Aydın et al. [34] determined as 19.3 years.

In the present study, when the answers of the participants' views on beekeeping as a source of livelihood are evaluated, 22.8% of them see beekeeping as a primary occupation, while 51.7% see it as a secondary occupation. The rate of those who consider beekeeping as a tertiary occupation is 17.0% and the rate of those who consider it as the only source of livelihood is 8.5%. These findings show that most beekeepers consider beekeeping as an additional source of income (P<0.01). Considering beekeeping as a source of livelihood offers an important economic opportunity especially for people living in rural areas. This profession should be understood as an environmentally friendly and sustainable livelihood in touch with nature. The reason why beekeeping and bee products are not fully utilised in Turkey may be due to the fact that beekeepers do not consider beekeeping as their only source of livelihood. The results of this study were similar to the results reported by Köseman *et al*. [10] and the results reported by Inci *et al.* [27], but lower than the results reported by Inci et al.

When the number of hives in the apiary of the participants is evaluated, 53.7% of them have 51 or more hives, 28.6% have 11-50 hives and 17.7% have 10 or less hives. This shows that most of the participants have a high number of hives (P<0.01). The majority of the beekeepers (92.0%) overwinter their bees in the open field, while 8.0% overwinter their bees indoors. Overwintering method may have significant effects on bee health according to climatic conditions (P<0.01). In addition, 52.7% of the participants were engaged in stationary beekeeping and 47.3% were engaged in mobile beekeeping. These rates show that beekeepers prefer both stationary and itinerant beekeeping widely. The results of the present study are lower than the rate of itinerant beekeeping reported by Karlıdağ and Köseman [1] in Malatya and Kutlu and Kılıç [35] in Elazığ. This difference in the present study, which was conducted throughout Turkey, may be due to regional differences in other studies.

In this study, when the product marketing methods of the participants were evaluated, 82.8% of them market the bee products produced by themselves as retail, while 17.2% of them sell them wholesale. These findings reveal that beekeepers mostly prefer individual marketing (P<0.01). While 62.1% of the participants stated that they were members of the Bee Breeders Association, 37.9% stated that they were not. This situation shows that union membership is common among beekeepers (P<0.01). Half of the beekeepers produce honey (4.6%), 28.4% produce pollen, 16.6% produce propolis, 3.2% produce bee bread and 2.2% produce royal jelly. The variety of products produced shows that beekeepers produce different bee products (P<0.01). While 33.5% of the beekeepers used experienced beekeepers as a source of information, 27.1% used the internet, 17.6% used books, 7.2% used non-governmental organisations, 5.6% used ministry organisations and 5.1% stated that they did not need any information source. It shows that beekeepers mostly benefit from experienced beekeepers and the internet in accessing information.

When these findings are analysed in detail, it is revealed that most of the beekeepers in Turkey consider beekeeping as an additional income and have been in this sector for many years. Especially the sharing of experience and knowledge is an important factor in ensuring sustainability in beekeeping. While the fact that beekeeping is seen as the second source of livelihood emphasises the professionalisation potential of the sector, it is seen that increasing marketing support and trainings can contribute to productivity. In addition, the fact that the participants mostly market bee products themselves shows the importance of branding and product value creation. In summary, supportive studies on the information sources, production and marketing methods of beekeepers in Turkey can contribute to the development of the sector.

The data on queen supply, queen replacement interval, queen importance and quality criteria knowledge levels and satisfaction of beekeepers for their colonies were analysed. In line with the opinions of the participants, their thoughts about queen bee were evaluated in various aspects and the results of the study are presented in TABLE III.

TABLE III.
Beekeepers' opinions on queen bee supply and queen bee management in the colony

Questions	Answers	Frequency	
		n	%
How do you obtain the queen bee?	I buy	114	27.7
	I produce by grafting	114	27.7
	I produce by queenless method	121	29.3
	The colony produces queen bees by itself	63	15.3
	P	*	
At what interval do you change the queen bee in the colony?	Every year	85	20.6
	Every 2 years	272	66.0
	The colony changes automatically	55	13.4
	P	**	
How important do you think the queen bee is to the colony?	Not important	20	4.8
	Partially important	9	2.2
	Very important	383	93.0
	P	**	
Do you know the queen bee quality criteria?	Yes	320	77.7
	No	30	7.3
	Not sure	62	15.0
	P	**	
What is your queen bee satisfaction status in your colonies?	Good	201	48.8
	Medium	201	48.8
	Bad	10	2.4
	P	**	
	Total	412	100

*: P<0.05, **:P<0.01

In the present study, 27.7% of the beekeepers purchase queen bees for their colonies commercially, while 57.0% of them produce them themselves. On the other hand, 15.3% of the beekeepers do not make any application and wait for the colonies to produce queen bees by themselves. This shows that beekeepers produce queen bees by themselves (P<0.05). The majority of the beekeepers (66.0%) change the queen every two years. According to the opinions of the participant beekeepers, it was emphasised that queen bee is very important for a colony (93.0%). The majority of the beekeepers (77.7%) stated that they knew the queen quality criteria (P<0.01). In addition, beekeepers reported that they were satisfied with the colony performance of queens at good (48.8%) and medium (48.8%) levels (P<0.01).

In similar studies, Seğmenoğlu [36] in Adana, Albayrak [24] in Sinop, 86.0%, Tosun [37] in Van, 64.8%, Turhan [38] in Sivas, 32.0%, İnci *et al.* [27] reported 56.4%. Kutlu and Kılıç [35], in their study conducted in Elazığ, reported that 26.0% of the beekeepers changed the queen every two years, while 50.0% did not change the queen for various reasons. In addition, 81.0% of the beekeepers stated that they purchased their queens and 21.0% of them produced them themselves. However, in the same study, the queen acceptance rate of the beekeepers who purchased their queens was low and the dissatisfaction rate (76.0%) was high. When this situation is compared with the findings of the present study, it shows that the rate of those who sell their queens is quite low and beekeepers who produce queens for the colony themselves may also be satisfied with the colony performances. In addition, 50.0% of the participants reported that they did not change the queen in their colonies and produced their colonies by natural splitting [39]. In a study conducted in Van, it was reported that 73.33% of the mobile beekeepers and 76.09% of the stationary beekeepers did not purchase queen bees commercially but produced them from their own apiaries [40].

According to the findings, it is seen that the majority of the beekeepers have sufficient performance and practical skills in queen production for their colonies. The fact that the beekeepers change the queen in the colonies every two years shows that the beekeepers aim to minimise the negative effects of queen growth on the operations of the colony. In addition, it is seen that beekeepers pay attention to queen quality criteria and it is understood that beekeepers are generally satisfied with the performance of their queens. In this context, it is likely that beekeepers can achieve higher success in colony health and operations by standardising queen production, replacement performances and quality criteria standards and improving their experience.

In this study, the data of beekeepers' opinions on current beekeeping problems and colony losses are presented in TABLE IV.

TABLE IV.
Beekeepers' opinions about beekeeping problems and colony losses

Questions	Answers	Frequency	
		n	%
In your opinion, what is the most important problem of beekeeping in Türkiye?	High input costs	127	30.8
	Agricultural spraying	59	14.3
	Climate change	52	12.6
	Inadequate marketing of bee products	77	18.7
	Incorrect support policies	28	6.8
	Security and wild animal attacks	17	4.2
	Inability to find quality breeding queen bees and colonies	52	12.6
	P	**	
What do you think is the most important reason for colony loss in your apiary?	Diseases and pests	218	52.9
	Bee enemies (wasps, rodents, bee-eaters)	64	15.5
	Wintering conditions	62	15.1
	Nutritional deficiency	42	10.2
	Bee plundering	26	6.3
	P	**	
What diseases and pests do you encounter most in your apiary?	Varroa destructor	327	79.4
	Unknown colony loss	44	10.6
	Fool rot	19	4.6
	Nosema	13	3.2
	Lime and stone disease	9	2.2
	P	**	
When do you combat Varroa desructor?	In spring	18	4.3
	In autumn	35	8.5
	When Varroa desructor is seen	33	8.0
	Early spring/Late autumn	317	77.0
	I do not fight	9	2.2
	P	**	
	Total	412	100

**:P<0.01

In the present study, high input costs were stated as the most important problem of Turkish beekeeping by 30.8%. Lack of marketing of bee products was mentioned by 18.7% of the beekeepers, 14.3% of the beekeepers stated that it was caused by agricultural pesticides, 12.6% of the beekeepers stated climate change and problems in the supply of quality breeding queens and colonies. Security problems and wild animal attacks were mentioned by 4.2% and inaccuracy of support policies by 6.8% (P<0.01). İnci *et al*. [27] in Bingöl, 44.7% of the beekeepers reported location and accommodation, 41.5% reported pesticides, 10.6% reported foreign beekeepers and 3.2% reported theft problems. It is seen that the data of this study are not compatible with the findings of the present study. This difference is due to the difference between the local study and the Turkey-wide study and it shows that there is no location and accommodation problem in Turkey. In addition, Köseman *et al*. [10] reported that the most important beekeeping problem was the lack of quality breeders (68.45%) in a similar study conducted in Malatya. The fact that this result is considerably higher than the data of the present study indicates that the problem of quality breeding has decreased recently since the producers have been producing queen bees themselves.

The loss of colonies in honey bees is caused by the combined stress effect of existing and non-existing diseases, pesticides, lack of floral resources, parts of semi-natural habitats and various forms [41]. According to the results of the research, diseases and pests are the most important factors causing colony losses with 52.9%. This is followed by bee enemies such as wasps, rodents, bee birds with 15.5% and wintering conditions with 15.1%. Nutrient deficiency and bee raiding were among the causes of loss with 10.2% and 6.3%, respectively (P<0.01). These results are similar to those of Şeker *et al.* [11] reported that the most important factor causing colony loss was diseases and pests (53.02%) in their study conducted in Malatya. In addition, İnci *et al*. [27] in Bingöl reported that 58.5% of the beekeepers received help from other beekeepers in the control of bee diseases and pests.

The most common disease and pest encountered by beekeepers is Varroa destructor with 79.4%. It was determined that the rates of unknown colony loss were 10.6%, brood rot 4.6%, Nosema 3.2% and lime-stone disease 2.2% (P<0.01). When the time of Varroa destructor control was examined, the majority of beekeepers (77.0%) stated that they carried out this control in early spring or late autumn. 8.5% fought in autumn, 4.3% in spring, 8.0% fought against Varroa, and 2.2% did not fight at all (P<0.01). Şeker *et al*. [11] reported in their study in Malatya that the most common disease and pest encountered by beekeepers in their apiaries was Varroa destructor (47.8%). The results of the current study were found to be higher than the results of this study. In another study, beekeepers reported that they experienced 81.2% wintering loss and that the highest loss (39.8%) of these colony losses was due to the queen bee and 23.8% to varroa [42]. It is thought that this difference may be due to the fact that it was done in different periods and that colony losses due to varroa destructor may have increased in recent periods.

These data reveal the main problems faced by beekeepers in Turkey and the main reasons for colony losses. Firstly, the fact that high input costs are stated as the most important problem shows the sustainability of the flow of beekeeping costs in the sector. The fact that agricultural spraying and climate change are among the important problems indicates the degree to which extensive beekeeping has deteriorated. Agricultural systems can increase colony losses that negatively affect bee health, and climate change can be linked to the prevention of bees from directly accessing food sources. Existing diseases and pests stand out as the main reason for colony losses. This shows that diseases and pests, which beekeepers constantly fight for colony health, are the biggest factor in colony loss. The fact that Varroa destructor is reported as the most common problem with a high rate of 79.4% in particular shows how critical it is for beekeeping to collect this pest on a control basis for sustainability.

CONCLUSİON

As a result, this study reveals the current problems of beekeepers and their perspectives on colony losses and evaluates how sustainable production can be achieved by addressing the basic problems in the beekeeping sector. The demographic structure, information sources, production and marketing methods, and the basic problems encountered by the people engaged in beekeeping in Turkey regarding queen bee supply and management have been revealed. It has been determined that the vast majority of beekeepers are male, middle-aged, married and have higher education levels, and that they generally consider beekeeping as an additional source of income. In addition, the fact that the majority of beekeepers produce queen bees and change queen bees every two years demonstrates an effort to ensure continuous production. According to the views of the beekeepers, it is seen that colony losses, seasonal conditions, bee disease transmission, malnutrition and pesticide use are interconnected. In the light of these findings, it is recommended that young beekeepers be included in the sector, as well as more comprehensive education and marketing support for the development of the beekeeping sector. The study emphasizes the necessity of local and national policies and practices for the sustainability of the beekeeping sector and the reduction of colony losses.

Conflict of interest statement

The authors declare there is no conflict of interest.

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