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Research Article

Community Perception on Beekeeping Practices, Management, and Constraints in Termaber and Basona Werena Districts, Central Ethiopia

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Adequate forage availability coupled with favorable and diversified agroclimatic conditions of Ethiopia creates environmental conditions conducive to the growth of over 7000 species of flowering plants which have supported the existence of large number of bee colonies in the country. Despite its potential of honey production, the contribution of apiculture to state GDP is far below its expectation and not well estimated yet. The objective of this study was to assess community perception in beekeeping management and constraints in central Ethiopia. 384 household heads were randomly selected from eight sentinel kebeles. Semistructured questionnaire, in-depth interview, and focus group discussions were employed to gather data. Chi-square (χ^2) test was used to determine association. Three beekeeping management systems, namely, traditional, transitional, and modern beekeeping, were documented. Beekeeping was reported to create job opportunity for landless men and women for their livelihood and needs low capital to start. Significant difference ($p < 0.05$) in beekeeping management activities between two districts was reported. Even though honey production is increasing, the trends of transferring traditional beekeeping to modern beekeeping practice showed a decline. Training and building capacity for hive management, colony feeding, and honey harvesting should be put in place in order to improve honey production.

1. Introduction

Adequate forage availability coupled with favorable and diversified agroclimatic conditions of Ethiopia creates environmental conditions conducive to the growth of over 7000 species of flowering plants which have supported the existence of large number of bee colonies in the country [1]. Ethiopia's wide climatic and geographical variability have endowed this country with diverse and unique flowering plants, thus making it highly suitable for sustaining a large number of bee colonies and the long-established practice of beekeeping. In Ethiopia only honey and beeswax are produced. Despite the suitability of the country for beekeeping and long period of introduction of improved beekeeping to the country, beekeeping expansion was very low and its contribution to honey production and the number of beekeepers participated are very minimum. Apiculture is successfully adopted by all levels of people such as men, women, and youth in many parts of the country yet high value bee products like propolis, pollen grain, royal jelly, bee venom, and others have not started to be exploited [2, 3].

Unlike modern beekeeping method which was only recently introduced, traditional beekeeping practice has been known for long period of time in Ethiopia. There are three different types of hives, namely, traditional, transitional, and modern hives, currently being used in different parts of the country with traditional hives constituting the overwhelming majority [3, 4]. The country remains the leading honey producer as well as one of the largest beeswax exporters in Africa. However, the share of the subsector in the gross

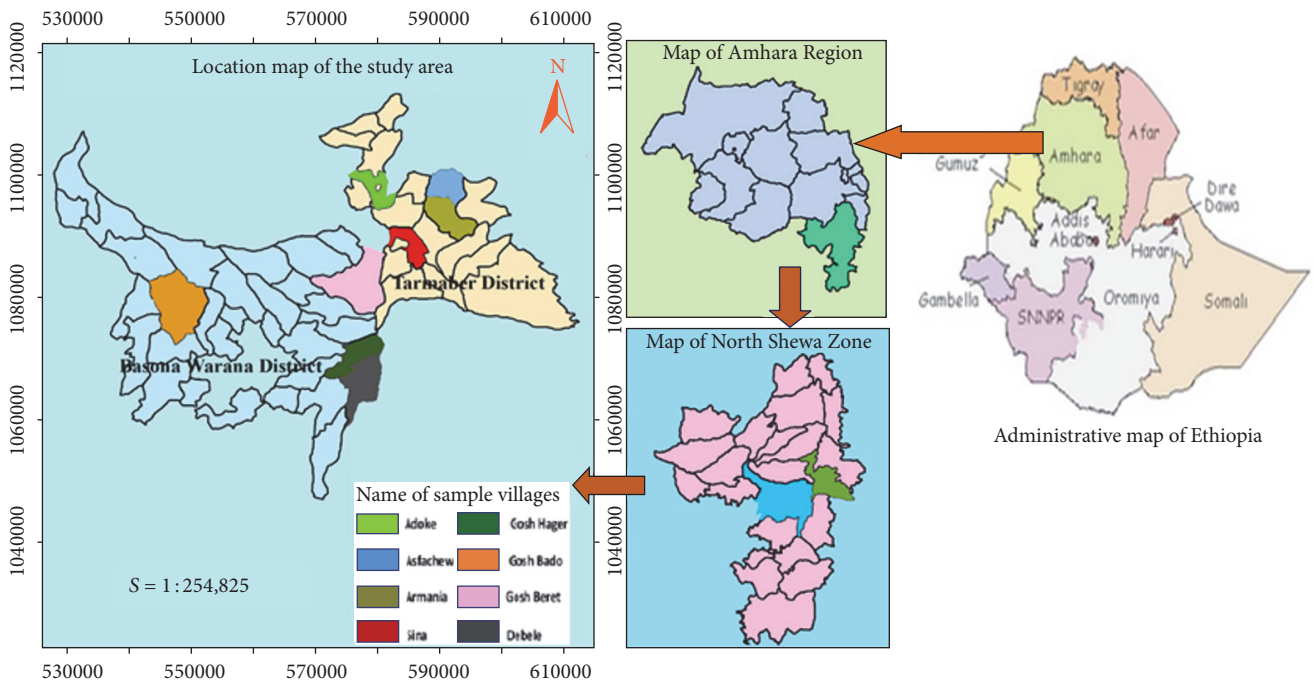

Figure 1: Map of the study area.

domestic production has never been proportionate with huge numbers of honeybee colonies and the country's potential for beekeeping. Production has been low, leading to low utilization of hive products domestically and relatively low export earnings. Thus, the beekeepers in particular were less benefited and the contribution of beekeeping subsector to the state GDP was limited [5].

Nevertheless, in Ethiopia the total volume of exported honey between 2000 and 2008 has been significantly increasing from 1.5 tons in 2000 to 275 tons in 2010 and more than 730 tons in 2012 [6–8] and the export trade of Ethiopian honey has reached more than 2.43 million USD [7]. The involvement of honey and beeswax processing companies is also increasing with 17 honey and beeswax processing companies registered in 2008 [6]. The major destinations of Ethiopian honey include Sudan, Norway, UK, Saudi Arabia, Kuwait, Yemen, and other European countries and USA [8].

Constraints such as diseases, pest and predators, droughts, deforestation, and chemical pesticides were found to be key factors that underestimated beekeeping subsector contribution [9]. Moreover, lack of knowledge, shortage of trained manpower and equipment, and inadequate research and extension service have been well described to reduce the apiculture subsector production [9–11].

Termaber and Basona Werena districts in central Ethiopia are not exceptions to the above facts. The districts are covered with natural vegetation, shrubs and man-made forest, annual and perennial crops. Moreover, it has adequate water resources and large bee colonies which create conducive environment for beekeeping. However, no systematic study has been conducted in the area regarding the beekeeping trends, management, and constraints associated with the sector. Therefore, the aim of this study was to assess community perception in beekeeping management and constraints associated with the sector in the study area.

2. Materials and Methods

2.1. Description of Study Area and Period. This study was conducted starting from March 1 to May 30, 2014. The study area is located in Termaber and Basona Werena districts, Northern Shewa Zone in Amhara Regional State, Ethiopia (Figure 1). Termaber is found at latitude of 9°50′60.000″N and longitude of 39°46′0.120″E. Its altitude is ranging from 1500 to 3100 m.a.s.l. The average annual temperature is about 15.5°C and the mean monthly rain fall is about 1200 mm [12].

Basona Werena is also district in the Amhara Regional State of Ethiopia located in Semien Shewa Zone. The district is found at latitude of 9°30′00″ and longitude of 39°30′00″E. The altitude ranges from 1,300 to 3,650 m.a.s.l, temperature (°C) is 6–20, and the mean monthly rain fall ranges from 1200 to 950 mm [9].

2.2. Study Design. The study design was community-based cross-sectional design. This includes interviewing 384 representative beekeepers randomly taken from two districts. Key informants and supervisors also participated in giving important information about the beekeeping management and constraints from the study area. The study design considered the agroecological zones of the study area.

2.3. Sample Size Determination. Sample size of the study was determined using a formula for single population proportion following Cochran [13] and proportional allocation was

employed to determine the sample size for each district. Hence,

$$n = \frac{n_0}{(1 + n_0/N)}, \quad (1)$$

where $n_0 = (Z^2_{a/2}pq)/d_2$, n = sample size, d = margin of error, N = total population, p = proportion of population, α = level of significance, and n_0 = standard calculated sample population.

Thus a total sample size of 384 beekeepers was taken in the two districts, of whom 153 were from Basona Werena and 231 were from Termaber districts.

2.4. Data Collection Instruments. Quantitative and qualitative data collection methods were used to collect relevant data. Observations, in-depth interviews, semistructured questionnaire, and focus group discussions (FGDs) were used as data collection tool to gather primary data from study participants.

2.5. Data Collection Method. Data was collected by using interview to key informants (satellite agricultural development agents located in each kebele, district agricultural development focal persons, and district administrator) and house to house survey of selected beekeepers. Checklist was prepared in advance consisting of different questions in English language and translated into Amharic language for each category of the key informants that help to conduct key informant interviews.

A semistructured questionnaire was prepared and included questions about beekeeping management, constraints, and comments of beekeepers about beekeeping activities. To conduct the household survey field guide person was selected from the study area. The selected respondents were interviewed through semistructured questionnaire.

In addition to the above two data sources, focus group discussion was carried out purposely which included development agents, supervisors, and model beekeepers. Furthermore, FGD members were carefully selected considering gender, age, religion, and villages that can represent different agroecological setup of the study area to get key information. The beekeepers selected for the focus group discussion were those beekeepers that were not included in the household survey and were known by their beekeeping performance. They were selected with help of development agents.

2.6. Data Analysis. Data was entered into a computer, checked for consistency and completeness, and cleaned. Frequency tables were analyzed using Microsoft Excel and statistical testing was made using SPSS version 16.0 software package. Chi-square (χ^2) was used to compare categorical data with respect to beekeeping management and constraints. Percentages and frequency distributions were used to describe socioeconomic characteristics and beekeeping management and constraints. The qualitative data collected from interviews, focus group discussions, and direct observations were analyzed using descriptive statistics.

Table 1: Sociodemographic characteristics of beekeepers in the two study areas.

	Termaber (n = 231)		Basona Werena (n = 153)	
	N	%	*N*	%
Sex of respondent				
Male	194	84	126	82
Female	37	16	27	18
Total	*231*	*100*	*153*	*100*
Age of the respondent				
18–60	189	82	128	84
>60	42	18	25	16
Total	*231*	*100*	*153*	*100*
Marital status				
Married	197	85	129	84
Single	34	15	24	16
Total	*231*	*100*	*153*	*100*
Education level				
Illiterate	142	62	77	50
Literate	89	38	76	50
Total	*231*	*100*	*153*	*100*

Table 2: Types of beekeeping methods in the study area.

	Termaber (n = 231)		Basona Werena (n = 153)		p value
	N	%	*N*	%	
Traditional	214	92.64	122	79.34	0.000
Modern	17	7.36	31	20.64	
Total	231	100	153	100	

3. Results

3.1. Sociodemographic Characteristics of Respondents. Of the total respondents, 84% and 82% in Termaber and Basona Werena districts were males, respectively. The modal age of beekeepers was 46 years, ranging from age of 39 to age of 59 years. In terms of marital status, 85% and 84% in Termaber and Basona Werena district, respectively, were married, while 62% and 50% of respondents in Termaber and Basona Werena district, respectively, were illiterate (Table 1).

3.2. Beekeeping Methods Observed in the Study Area. Majority of the beekeepers (92.64% and 79.34% in Termaber and Basona Werena districts, resp.) have little knowledge on the modern beekeeping management, although there was introduction of modern bee hives in the area. Most of the respondents did not know the application of intermediate and frame bee hives in the study area (Table 2). Significant difference ($p < 0.05$) in beekeeping system was observed between Termaber and Basona Werena districts with beekeepers from Termaber mostly depending on traditional system of bee honey production.

Table 3: Knowledge and necessary skills training offered to the respondent.

	Termaber (n = 231)		Basona Werena (n = 153)	
	N	%	N	%
Colony split	8	3.5	6	3.9
Honeybee colony management	15	6.5	14	9.2
Processing, handling & storage	2	.9	4	2.6
Market information & networking	6	2.6	3	2.0
Input utilization	4	1.7	1	0.7
Bee forage management	5	2.2	2	1.3
All types of training	12	5.2	17	11.1
No training	179	77.5	106	69.3
Total	231	100	153	100

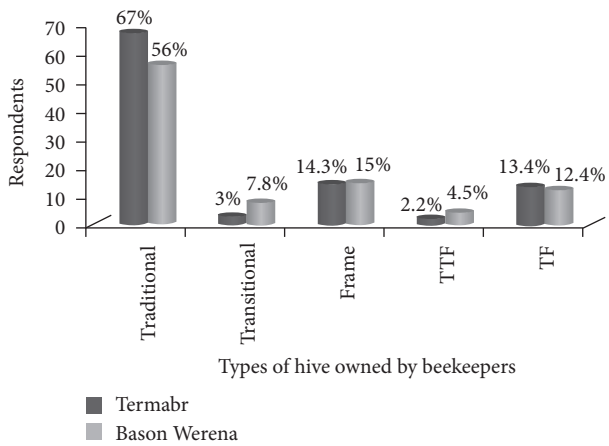

Figure 2: Hive ownership of beekeepers (TTF = Traditional, Transitional, and Frame; TF = Traditional and Frame).

3.3. Beekeeping Knowledge and Necessary Skills Reported in the Study Area. Of the total respondents, 77.5% and 69.3% did not get training to develop their capacity for beekeeping management in Termaber and Basona Werena districts, respectively (Table 3).

3.4. Commonly Used Bee Hives in the Study Area. Three types of hives, namely, traditional, transitional, and modern hives, were reported. Of the three reported hive types, 67% and 56% of the hives in Termaber and Basona Werena districts, respectively, were traditional hives. 14.3% and 15% from Termaber and Basona Werena districts, respectively, were found to be modern; 3% and 7.8% of the hives from Termaber and Basona Werena districts, respectively, were of transitional type and the rest were combination of either the three types or two types from the aforementioned hives (Figure 2).

3.5. Materials for Traditional Hive Construction in Study Area. According to the respondents, different locally available materials such as bamboo, climbing plants, and dung were used in order to construct traditional hives. Of these, the most dominant type of hive was reported to be bamboo hive plastered with dung, which accounts for 70% and 56% in Termaber and Basona Werena districts, respectively (Table 4).

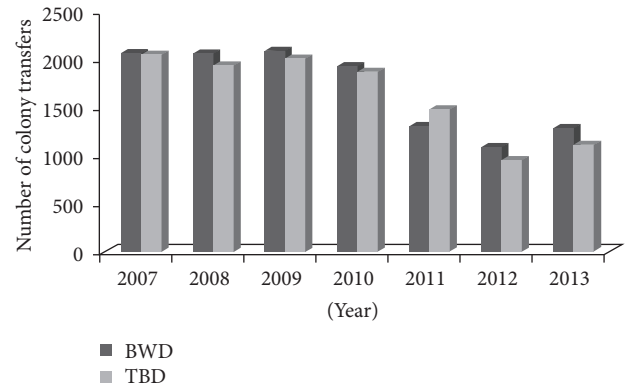

Figure 3: Status and trend of hive transformation in the study area (source: Termaber and Basona Werena Agriculture Office, 2014).

Table 4: Materials for traditional hive construction.

Number of hives made of raw materials	Termaber (n = 231)		Basona Werena (n = 153)	
	N	%	N	%
Bamboo	161	70	86	56
Tree branch & tendril	49	21	44	29
Clay	6	3	2	1
Animal dung	15	6	21	14
Total	231	100	153	100

3.6. Status and Trend of Colony Transformation. Figure 3 shows trends of transferring of traditional bee colonies to transitional and frame hives from 2007 to 2013. In 2007 there was the maximum number of colony transfers of traditional bee colonies to transitional and frame hives in both districts. However, the trend of transferring showed a decline from 2007 to 2013 in both districts. The least transformation was reported in 2012.

3.7. Honey Production Season. The peak honey harvesting season of the study area was reported from October to November (76% and 71%) followed by January to February (21% and 17%) in both Termaber and Basona Werena districts, respectively (Table 5).

3.8. Trends of Honey Production. Even though the trend of honey production showed fluctuation from 2006 to 2012, there was steady increase starting from 2010 to 2012 and 2011 to 2012 in Basona Werena and Termaber districts, respectively (Figure 4).

3.9. Disease Control Mechanism. Sixty-seven percent and 71% of the respondents from Termaber and Basona Werena

Table 5: Honey production period.

	Termaber (n = 231)		Basona Werena (n = 153)	
	N	%	N	%
October-November	175	76	109	71
January-February	48	21	26	17
May-June	8	3	18	12
Total	231	100	153	100

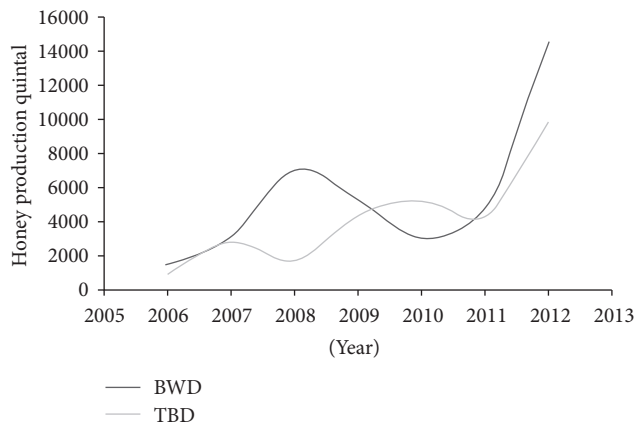

Figure 4: Trends of honey production (source: Termaber and Basona Werena Agriculture Office, 2014).

Table 6: Reported mechanism of disease control.

	Termaber (n = 231)		Basona Werena (n = 153)		p value
	N	%	N	%	
Traditional methods	00	00	00	00	
Metal or plastic covering	155	67	108	71	0.471
Modern medicine	00	00	00	00	
Nothing is used	76	33	45	29	
Total	231		153		

district, respectively, reported that they protect their colonies by simple protective measures, such as using metal or plastic covering to their hives. However, 33% and 29% of the respondents from Termaber and Basona Werena district, respectively, reported that they had no significant means to protect their hives from disease. There was no significant difference in disease control mechanism in both districts in the study area (Table 6).

3.10. Opportunities for Beekeeping Development and Honeybee Flora Source. Beekeeping is a sustainable form of agriculture, which is beneficial to provide economical reasons for increased income and means of food security in Termaber and Basona Werena districts. According to the respondents, there was still huge potential to increase honey production and to improve the livelihood of the beekeepers in Termaber and Basona Werena districts. There were also some NGOs giving more attention to the subsector undertaking important intervention to support the development of beekeeping practice in the study area.

According to the respondents it would give an opportunity to landless peasants to practice beekeeping for their livelihood. As the respondents indicated in the study area beekeeping can create job opportunity in which family members can participate in keeping apiary site and harvesting and selling the products. The respondents also suggested that hive occupies very little space and bees can collect nectar and pollen from anywhere they can get. Therefore, beekeeping subsector can be practiced with small holdings and small capital and with hives made using local materials in a sustainable way. Moreover, respondents indicated that they have the opportunity to benefit by making hives equipment and from value added products such as beeswax and colony.

Table 7 presents the list of flowering plant species used as source of nectar for honeybees reported by the respondents from Termaber and Basona Werena districts at various seasons of the year.

3.11. Constraints Associated with Beekeeping in the Study Area. Different constraints, associated with beekeeping and apiary products in the study area, were stated below in Table 8. All (100%) of the respondents in Termaber district and 85% of the respondents from Basona Werena district reported that colony absconding problem existed that undermined the beekeeping practice in the study area. Lack of enough space for beekeeping was a problem in both districts. The majority, 94.4% and 88.9% of the respondents from Termaber and Basona Werena districts, respectively, reported that honeybee is affected by drought. Moreover, 46.3% and 70.6% of the respondents from Termaber and Basona Werena districts, respectively, indicated that honeybee colony is affected by bee diseases.

4. Discussion

Demographic assessment of peoples who participated in this study has shown that both sexes and all age groups greater than eighteen years of age were involved in beekeeping with the majority of them found to be male. Majority of the beekeepers were married, male, and illiterate in both Termaber and Basona Werena districts. A similar result was reported by Yirga and Ftwi (2010), Awraris et al. (2012), and Chala et al. (2012) from northern and southwestern Ethiopia who reported that both sexes and age have great role in beekeeping management [14–16]. However, in the current study, most of the beekeepers were male and illiterate as compared to females. The involvement of few females and illiteracy factor in beekeeping management could be attributed to the cultural influence existing in the study area. This is also in agreement with the findings of the study by K. Tesfaye and L. Tesfaye (2007) that reported the involvement of few females' beekeeping management in central part of Ethiopia [17].

Table 7: Flowering plant species used as nectar source by honeybees and their flowering period.

Plants habits	Local Name	Scientific name	Flowering Period
Trees	Bahr-Zaf	*Eucalyptus camaldulensis*	May to June
	Tiqur Berbere	*Schinus molle*	Year-round
	Weyra	*Olea europaea*	April to June
	Lomi	*Citrus aurantifolia*	Year-round
	Zeitun	*Psidium guajava*	Year-round
	Mango	*Mangifera indica*	December to March
	Kinchib	*Euphorbia toritolli*	Year-round
	Girar	*Acacia seyal*	August to February
	Girawa	*Vernonia amygdalina*	December to May
	Besana	*Croton macrostachyus*	April to July
	Kolqual	*Euphorbia abyssinica*	September to November
	Papaya	*Carica papaya*	Year-round
	Muz	*Musa* x *paradisiaca*	Year-round
	Gulo	*Ricinus communis*	Year-round
	Anfar	*Buddleja polystachya*	Year-round
	Avocado	*Persea Americana*	October to December
	Wanza	*Cordia Africana*	October to March
	Keshushla	*Cirsium schimperi*	August to December
Shrubs	Tenjut	*Otostegia integrifolia*	Year-round
	Gesho	*Rhamnus prinoides*	Year-round
	Hareg	*Mikaniopsis clematoides*	November to March
	Agam	*Carissa edulis*	Year-round
	Atiuch	*Achyranthes aspera*	Year-round
	Asta	*Erica arborea*	Year-round
	EKtkttaa	*Caesalpinia decapetala*	October to January
	Dander	*Centaurea melitensis*	October to January
	Bakela	*Vicia faba*	September to October
Herbs	Ater	*Pisum sativum*	September to October
	Senafch	*Esinappis alba*	October to December
	Tosegne	*Satureja* spp.	September to December
	Baoiela	*Vicia faba*	September to October
	Mashla	*Sorghum btcotor*	October to December
	Telba	*Unum usitatissimum*	October to November
	Adguar	*Malva verticillata*	Year-round
	Shmbera	*Cicer arietinum*	October–February
	Serdo	*Eleusine floccifolia*	August to November
	Kamun	*Anethum foeniculum*	September to November
	Suf	*Carthamus tinctorius*	November–February
	Adey-Abeba	*Bidens pachyloma*	September and October
	Nug	*Guizotia abyssinica*	September to October
	Mech	*Guizotia scabra*	August–February
	Gomen	*Launaea cornuta*	October to December
	Besobla	*Ocimum urticifolium*	Year-round
	Duba	*Cucurbita pep o*	April to December
	Tosgn	*Thymus schimperi*	Year-round

Traditional beekeeping practice was the most predominant practice reported from both Basona Werena and Termaber districts. This could be due to lack of knowledge, shortage of experience sharing, and low awareness to adopt the transitional and frame hives. This is in line with the findings of the study by Amssalu et al. (2004) and Workneh (2011) who reported that beekeeping practice in south and southwestern Ethiopia is predominantly traditional [3, 18].

Experience sharing among beekeepers enables them to adopt the use of modern beehives. With regard to this,

Table 8: Constraints associated with beekeeping reported from the study area.

Constraints	Basona Werena (n = 153)				Termaber (n = 231)				p value
	Yes	%	No	%	Yes	%	No	%	
Colony absconding	146	95.4	7	4.6	231	100	—	00	0.001*
Lack of enough space	58	38	95	62	108	46.75	123	53.25	0.087
Droughts	136	89	17	11	225	97.4	6	2.6	0.001*
Poor society awareness	149	97.4	4	2.6	229	99	2	1	0.176
Pesticides poisoning	129	84.3	24	15.7	182	78.78	49	21.22	0.177
Lack of training	106	69.3	43	30.7	179	77.5	52	22.5	0.000*
Honeybee diseases	108	70.5	45	29.5	107	46.3	124	53.7	0.000*
Shortage of bee colonies	140	91.5	13	8. 5	228	98.7	3	1.3	0.01*
Lack of initial capital	149	97.4	4	2.6	211	91.3	20	8.7	0.176
Shortage of modern bee hives	143	93.5	10	6.5	205	88.7	26	11.3	0.120
Lack of experience sharing visit	141	92	12	8	195	84.5	36	15.5	0.130

*Significant at $p < 0.05$.

majority of the beekeepers in the study area were nontrained and mainly depend on indigenous way of managing their beekeeping which may not well match with the findings from other studies undertaken in eastern Tigray, northern Ethiopia, which documented that longer beekeeping experience for those beekeepers enables them to adopt the use of improved box beehives compared to beekeepers with short beekeeping experience [19, 20].

There was a shortage of beekeeping experience in Termaber and Basona Werena districts. Most beekeepers did not get training to build their capacity for beekeeping management. This might be due to less attention to the subsector which resulted in low transfer of skills and inadequate training in the study area. Independent study conducted by Workneh (2011) in order to identify and document the indigenous knowledge in beekeeping in Ethiopia concluded the necessity of training that provides technical competency and more exposure to the subject matter and helps to adopt the improved technologies to the beekeeper [18].

All three types of hives, namely, traditional, transitional and frame types, were recorded with the former being the most widely utilized. Traditional hives were made of bamboo, tree branch and tendril, animal dung, and clay. Of these the most predominant type of hive was the type of hives made of bamboo. Similar hive types were reported from central Ethiopia by Edessa (2005) who reported that all the three types of hives available were commonly practiced in different parts of Ethiopia [21].

Trends and status of transferring traditional hive to transitional and frame hive in the study area did not show much change over time. The possible reason for this could be the high cost of the improved hives and lack of awareness in the community. Most respondents from both districts do not know the advantage of beeswax. This might be due to lack of awareness, lack of processing material, lack of processing skill, and absence of market. Similar reports findings were reported by CSA (2008) that described that wax is mostly left or thrown away in Burie district of Amhara Region, Ethiopia [22].

Harvesting time in both districts in this study ranges from one to three times a year; however, the most productive harvesting season was reported to be from October to November. This might be mainly attributed to the offset of the rainy season which results in the flowering of diverse plant species. This was supported by the report of CSA (2008) and Mathewos et al. (2004) who indicated that the major honey flow season was November to December in different parts of Ethiopia [22, 23].

In this study 6 years of honey production data record was presented and it indicated that even though there existed fluctuation from 2006 to 2012, there was steady increase starting from 2010 from 2000 kg/yr/district in 2005 to 14,000 kg/yr/district in 2012. Similarly reports from Benishangul, western Ethiopia, and review report by Gemechis (2014) showed that honey production in Ethiopia increased in the last decade [24, 25]. This might be due to the introduction of transitional and frame hives and policy guidance. However, the products obtained from this subsector are still low as compared to the potential of the country [26, 27].

In this study beekeepers mainly depend on traditional control methods, such as metal or plastic covering, to protect their hives from pests and significant proportion of farmers expressed lack of any control mechanisms. Similar study was undertaken in Adami Tulu Jido Kombolcha district, central Ethiopia, and documented that beekeepers had no disease control mechanisms [17].

According to the respondents, there are various flowering plants species used as source of nectar for honeybee. More than 40 plant species including trees, shrubs, and herbs that could be used as potential pollen and nectar sources were recorded with some examples including plants flowering throughout the year such as *Schinus molle*, *Olea europaea*, *Citrus aurantifolia*, *Psidium guajava*, *Buddleja polystachya*, *Erica arborea*, *Carica papaya*, *Carissa edulis*, *Rhamnus prinoides*, and *Musa* x *paradisiaca*. Similarly a range of potential sources of pollen and nectar, including plant species in our report, have been documented in expeditions made from different parts in the country [23, 26, 27].

In this study it is reported that lack of skilled manpower, colony absconding, drought, honeybee diseases, and shortage of bee colonies were the major constraints that undermine the beekeeping practice in the study area. This could be mitigated by offering training to farmers in swarm control methods, colony management, and disease detection and prevention. Similar constraints have been documented from Amhara, Oromia, and Tigray regions [11, 28–31] including shortage of bee forage due to population pressure, the high demand for farmlands around mountainous areas, livestock grazing, the existence of pests, and problem of absconding being the factors which endangered the health of local honeybees and production of honey in different agroecology zones.

5. Conclusion

Beekeeping is found to be practiced by all ages in the community starting from late adolescence and both sexes made it as one source of income. Traditional hives mainly made of bamboo, tree branch or "hareg," animal dung, and clay were the main choices in the study area. Even though the trend of honey production showed fluctuation from 2006 to 2012, there was steady increase starting from 2010 to 2012 and 2011 to 2012 in Basona Werena and Termaber district, respectively.

Lack of skilled manpower and training institutions, low level of technology used, poor quality of honey harvesting, absconding, drought, poor society awareness about beekeeping practice, shortage of bee flora, pesticides poisoning, honeybee diseases, shortage of bee colonies, shortage of modern bee hives, and marketing problems were reported to be the major constraints that undermine the beekeeping practice in the study area. Thus all stock holders in the sector of beekeeping should integrate their effort particularly at the level of both administrative districts in order to modernize the beekeeping farming via training the farmers and encouraging them to shift from traditional to modern way of beekeeping.

Competing Interests

The authors declare that they have no competing interests.

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