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Beekeeping practice and honey production potential in Afar Regional State, Ethiopia

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Abstract. The contribution of beekeeping is perhaps one of the most important income-generating activities for millions of smallholder farmers in Ethiopia. This study was intended to assess beekeeping practices and potential in three districts of Afar Region, northern Ethiopia. Primary data were collected from 120 respondents proportionally selected from each district. Semi-structured questionnaire were employed to collect the primary data. Focus-group discussion was also used to support interpretation of the interview data. Basically, descriptive statistics were used to analyse the data. All respondents use traditional honey production system despite some recent trials. The mean live colony ownership of the sample beekeepers is 10.08 colonies per household, with a maximum ownership of 62 colonies. The study showed that the annual honey production per beehive varies from 4 to 17 kg, with a mean production of 9.66 kg. The majority of the respondents harvest two times per year, while 18%, 19%, and 14.2% of the respondents harvest three, four, and five times per year respectively. This might be due to the special floral calendar of tropical plants found in the areas. 67.5% of respondents supplement their colonies during dry season. Producers travel more than seven kilometres to sell their honey. On average, beekeepers sell 77.86 kg per year individually, with a range of 0 to 353 kg. The main constraints of honey production in the area are recurrent drought, poor extension service, lack of access to improved technology, deforestation, etc. Therefore, it requires intervention to change the old beekeeping practices through training and introducing improved production systems.

Keywords: beekeeping, marketing, constraints, bee flora, Ethiopia

1. Introduction

Beekeeping is an important venture used for strengthening the livelihood of rural community. It generates a variety of production and respective assets [1]. It is a promising non-farm business, which contributes to smallholder's income and national economy. It has a substantial role in generating and diversifying the income of Ethiopian smallholder farmers. It is important mainly for small landholders and landless youths [2, 3]. Ethiopia is the home of diverse fauna due to its varied ecological and climatic conditions [4, 5]. This is the prime reason for the availability of large colony numbers in the country. In Ethiopia, three types of beehives (traditional, transitional, and improved) are known, with more than 10 million colonies, from which more than 70% are estimated to be colonized [6, 7]. Ethiopia is endowed with diverse agroclimatic zones, which are suitable for honey production. The annual honey and beeswax production is estimated around 53,680 and 4,700 tons respectively [8, 9], yielding 13% of the agricultural GDP [10]. The greater portion is harvested from traditional hives [11]. Accordingly, Ethiopia is ranked 10^{th} and 4^{th} in honey and beeswax production worldwide respectively [12, 13].

Thus, while the country is the principal producer of honey, it has the potential to improve yields and harvest more if existing beekeepers are able to overcome significant issues regarding inputs, technical skills, and climate change adaptation [14]. In order to exploit the country's production potential, the current government has given consideration to developing the beekeeping subsector as a strategy for the reduction of poverty and the diversification of export commodities [7]. Attention is also given to upgrading the knowledge and skill of development agents and beekeepers so that they can develop better apicultural knowledge and skills that enable them to improve traditional beekeeping and increase the production of hive products [15]. Moreover, different non-governmental organizations intervene to support the poor and the formation of beekeepers' cooperatives and unions to bring substantial changes to the increased supply and consistent quality of honey and beeswax that will subsequently enable the smallholders as well as the country to benefit from the subsector. Besides, the federal and regional agriculture and rural development bureaus have improvement strategies aimed at increasing the quality and quantity of hive products [7, 16].

Food insecurity is being exacerbated by the prolonged drought and accelerated frequency of shocks and stresses. This is bringing many communities deeper into a state of recurrent or chronic vulnerability and severe food insecurity [17, 18]. Northern Afar is located at the lowland peripheries of Ethiopia, where it is known for its short rain season, wherefore crop production is highly constrained.

The increase in the frequency of droughts has impaired livestock production and reproductive performance in the area. Hence, beekeeping is the best alternative that can fit the current problems. Beekeeping is an old alternative traditional practice in the area. The communities possess large numbers of honeybee colonies, almost all in traditional hives. Some households possess more than 100 colonies, which is somewhat impressive based on an external perception. The promotion of apiculture development is therefore necessary in the area where crop production is hindered due to low and erratic rainfall. Arid and semi-arid honeybees have fast build-up as well as a fast honey-storing tendency, which are adaptive values for survival in arid lowland environments where flowering duration is short due to short raining and extensive dry periods.

However, the extent of production potential of the apicultural practice and contribution to the income generation of the society, in particular for the regional and in general for the national economy, have not been investigated yet. Therefore, the assessment of beekeeping potential and practice is a prerequisite to promote beekeeping development.

2. Materials and methods

The study area

The study area is situated in zone two of Afar Regional State positioned from 12 0 53’ 59” to 140 33’ 27” North and 390 38’ 43” to 400 55’ 20” East. It is categorized under arid and semi-arid climate with low rainfall and drought proneness. Rainfall is bi-modal with an annual rainfall of 407.2 mm. Temperature varies from 18.3 °C to 32.1 °C in higher and lower elevations respectively, with a mean annual of 25.2 [19]. There are three rainy seasons in the area. About 60% of the rainfall received during the main rainy season, the “karma”, occurred from the end of June to early September; this is followed by rainy showers from the end of December to mid-January, locally termed “dada”. This is followed by a minor rainy period from the end of March to mid-April, called “sugum”. The mainstay of communities in the area is livestock production followed by crop cultivation and beekeeping. The main honeybee floras are *Leucas abyssinica*, *Hypostus auriculata*, *Becium grandiorum*, *Acacia mellifera*, *Acacia tortilis*, *Acacia Senegal*, *Dobera glabra*, *Ziziphus mucronata*, *Opuntia*, *Cordia sinensis*, *Aloe elegance*, *Bidens macroptera*, *Acacia pilispina*, etc. Beekeeping in the districts is practised almost traditionally with the locally available materials, and the areas have a potential for honey production.

Data collection and analysis

Purposive and probability sampling procedures were used. A two-stage sampling technique was employed to select a beekeeper respondent. Among the administrative districts of the northern zone of the region, three districts were selected purposively based on their well-situated agroecology for beekeeping and honey production potential. In the second stage – using the list of beekeepers in the sampled area –, 120 beekeeper households were randomly selected based on the probability-proportional-to-size principle. The lists of beekeepers acquired from the administrative districts were used as a sampling frame. Moreover, key informant interviews and focus groups were selected from the chosen pastoral associations. A pre-tested questionnaire in a preliminary survey was prepared. The questionnaire contained dichotomous, multiple choice, and open-ended questions.

Honeybee floras were first identified using the local name and then followed by field-trip physical identification. Unfamiliar plants were identified using the botanical field guides and flora books of Ethiopia and Eritrea [20]. The analytical tool employed for this study was descriptive statistics using the statistical package for social sciences (SPSS version 20).

3. Results and discussions

Beekeeping potential

The mean live colony ownership of the sample beekeepers is 10.08 colonies per household, with a maximum ownership of 62 colonies (*Table 1*). This result is lower than the number observed in the Jimma zone (35 colonies per household) [21] and similar to the number recorded by [22]. A higher number of colonies was recorded in comparison with other reports [13, 23–26]. Honeybee colonies are the second important assets available to most of the respondent beekeepers in the North Afar. The ownership of honeybees in the area is regarded as having a secured and healthy family. Beekeeping has various benefits that support the improvement of pastoralists' economic and nutritional requirements. Successful beekeepers make a substantial contribution to family income and food security [27]. On average, 10.12 empty hives were recorded in the study area, which is almost equivalent to the number of colonized hives (*Table 1*). More than 98.2% of the respondents attribute these empty hives to absconding due to the prolonged drought in the area (*Table 2*). This indicates that beekeepers are not aware of intensive colony management during the shortage of availability of honeybee forage, on the one hand, and less follow-up by extension workers when problem emerged, on the other.

Table 1. The number of colonies and the number of empty hives in the sample respondents' possession

Variables	Districts						Total	
	Koneba		Berahle		Dallol			
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Number of colonized traditional hives	7.00	4.93	12.50	13.59	10.56	11.38	10.08	10.87
Number of empty traditional hives	4.30	3.73	15.64	14.70	9.86	13.13	10.12	12.49
Number of empty modern hives	0.30	0.52	0.0	0.0	0.19	0.47	0.16	0.41

Std. Dev. = standard deviation

Out of the 120 surveyed beekeepers, 51.7% start beekeeping by hunting down their initial colonies in forests and mountains, which is different from the result reported in other parts of northern Ethiopia, where 88.8% of the beekeepers collect their colonies by catching either flying or jangle swarms [28]. More than 96% of the beekeepers in the Gamo Gofa zone, Ethiopia, also collected their foundation colony by catching swarms [29]. A study report in the Jimma and Illibabor zones of Oromia Regional State indicated that more than 50% of beekeepers start their bee farms by catching swarming colonies [22]. These findings generally indicate that there is no standard colony marketing.

Table 2. Initial sources of colonies, reasons for empty hives, and apiary centres

Variables	Responses	Koneba		Berahle		Dallol		Total	
		N	%	N	%	N	%	N	%
Initial source of colony	Hunting	17	42.5	26	59.1	19	52.8	62	51.7
	Purchased	3	7.5	2	4.5	2	5.6	7	5.8
	Inherited	20	50.0	2	4.5	13	36.1	35	29.2
	Hunting and inherited	0	0.0	4	9.1	0	0.0	4	3.3
	Inherited and purchased	0	0.0	10	22.7	2	5.6	12	10.0
Apiary centre	Backyard	29	72.5	44	100.0	30	83.3	103	85.8
	Far from home	11	27.5	0	0.0	6	16.7	17	14.2
Reason for the empty hives	Absconding	35	97.2	44	100.0	33	97.1	112	98.2
	Sold	1	2.8	0	0.0	1	2.9	2	1.8

N = number of respondents

On average, 85.8% of the beekeepers keep their colonies near to their homestead (*Table 2*). This indicates they have no isolated apiary far from their home. This may lead to the disturbance of domestic animals, family members, and the colonies themselves. Isolated apiary increases colony stability, which is a key factor in increasing honey production. A disturbed colony always focuses on guarding and defending its nest, rather than collecting honey. During group discussions, respondents reflected that repeated conflicts with neighbours took

place due to attacks on domestic animals by the bees and visa vice. More than 20% of beekeepers in the Gamo Gofa zone in the Southern Region of Ethiopia kept their colonies in a simple shed built for hive placement, which is considered an independent apiary centre [29].

Honey production and productivity

Honey was the major hive product produced in the study area. About 73.3% of the respondents produced only honey, while 24.2% both produced honey and raised colonies (for sale) (*Table 4*). The survey showed that the annual honey production per traditional beehive ranges from 2 to 17 kg, with a mean production of 9.66 kg. The production observed in the study area was nearly similar to the production observed in the Atsbi Wemberta [23] and Kolla-Tembien [30] districts of Tigray and in eastern Amhara Region [24], which is geographically and agro-ecologically nearer to the study areas. It was higher than the production reported in the eastern zone of Tigray regional state [31, 32], Hadiya zone [33], the Gamo Gofa area of Southern Ethiopia [29], Jigjiga zone of Somali regional sate [34], Jimma and Illubabor [22], and South West Shewa [35] zones of Oromia regional state. Higher productions were reported by other authors in another areas of Ethiopia [21, 30, 36, 37]. The difference may be due to the agro-ecological suitability, water availability, and level of awareness of the beekeepers for colony management.

The average annual honey production per household of the surveyed beekeepers was 88.75 kg within a range of 4–372 kg (*Table 3*), which is nearly similar to the production reported in Tigray regional state [23, 30]. A lower annual honey production (23.35 kg) per household was observed in the West Arsi zones of Oromia region [13]. The survey indicates that the area has a high potential for honey production if additional technological inputs and extension service are delivered to the desired level.

Table 3. Annual honey production per hive and per household

Variables	Koneba		Berahle		Dallol		Total	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Honey production per hive	9.33	3.29	10.30	3.25	9.22	3.01	9.66	3.20
Honey production per household	66.15	42.12	110.00	86.97	87.25	64.97	88.75	70.13

Std. Dev. = standard deviation

Harvesting season and harvesting frequency

The frequency and peak of harvested honey varies depending on colony management practices and the flowering condition of honeybee flora [38, 39]. The harvesting frequency varies from district to district due to differences in honeybee flora across the range of altitudes in the study area. About 40.9% of the sample respondents in Berahle District reported to harvest four times per year and 31.8% reported to harvest five times per year, which is different from the mean harvesting frequency in other parts of the country [12, 32, 35, 38, 40].

Table 4. Sample respondents' hive products, season harvest, and harvesting frequency

Variables	Responses	Koneba		Berahle		Dallol		Total	
		N	%	N	%	N	%	N	%
Type of hive products produced	Honey	38	95.0	22	50.0	28	77.8	88	73.3
	Bees wax	1	2.5	0	0.0	0	0.0	1	0.8
	Honey and beeswax	1	2.5	0	0.0	1	2.8	2	1.7
	Honey and colony	0	0.0	22	50.0	7	19.4	29	24.2
Harvesting frequency per year	Once	0	0.0	0	0.0	0	0.0	0	0.0
	Twice	25	62.5	6	13.6	17	47.2	48	40.0
	Three times	15	37.5	0	0.0	7	19.4	22	18.3
	Four times	0	0.0	18	40.9	5	13.9	23	19.2
	Five times	0	0.0	14	31.8	3	8.3	17	14.2
Peak season of production	[1]Karma	8	20.0	22	50.0	14	38.9	44	36.7
	[2]Jilal	30	75.0	0	0.0	15	41.7	45	37.5
	[3]Sugum	2	5.0	2	4.5	0	0.0	4	3.3
	Karma and Sugum	0	0.0	20	45.5	7	19.4	27	22.5

N = number of respondents

In this district, the main honeybee flora is mostly made up of shrubs and trees that bloom in different seasons throughout the year, which is different from the conventional flowering period due to summer rain. In a single season, they harvest five to six times. In Koneba District, 62.5% of the sample beekeepers reported to harvest twice a year, which is similar to the harvesting frequency reported in different parts of Ethiopia [15, 23, 41], while 37.5% harvest three times per year. In Dallol District, 47.2%, 19.4%, 13.9%, and 8.4% of the respondents harvest twice, three times, four times, and five times a year respectively. Differences in

[1] From July to August.
[2] From December to January.
[3] From April to May.

harvesting frequency within the same district might be due to differences in colony management.

A larger percentage (37.5%, 36.7%, and 22.5%) of respondents indicated that the peak seasons of harvest are Jilal and Karma followed by Sugum (*Table 4*). These seasons are found next to the longer summer rain and the spring short rain periods. The result is similar to the report in Kilite Awlaelo District in Tigray regional state [31].

The potential of honeybee flora and supplementation

Bee forage types affect the quantity and quality [42] of honey yield obtained per colony [30, 31, 33, 43]. According to the sampled beekeepers, the existence of some special honeybee floras in the study district results in the production of good-quality and high-quantity honey and increases the frequency of harvests. More than 65% of the respondents replied that bee forage is highly available, and none of the respondents reported a reduced availability (*Table 5*).

Table 5. Availability of honeybee flora and colony supplementation

Variables	Responses	Koneba		Berahle		Dallol		Total	
		N	%	N	%	N	%	N	%
Availability of bee forage	Less available	0	0.0	0	0.0	0	0.0	0	0.0
	Medium	12	30.0	18	40.9	12	33.3	42	35.0
	Highly available	28	70.0	26	59.1	24	66.7	78	65.0
Colony supplementation	Yes	14	35.0	44	100.0	23	63.9	81	67.5
	No	26	65.0	0	0.0	13	36.1	39	32.5
Season of supplementation	Dry season	14	100.0	44	100.0	23	100.0	81	100.0
	Rainy season	0	0.0	0	0.0	0	0.0	0	0.0
	Harvesting period	0	0.0	0	0.0	0	0.0	0	0.0

N = number of respondents

The districts are very special for their diversified shrubs, trees, and herbaceous species such as *Acacia mellifera*, *Ziziphus spina-christi*, *Ziziphus mucronata*, *Acacia horrid*, *Balanites aegyptica*, *Acacia tortilis*, *Grewia ferruginea*, *Grewia penicillata*, *Salvadora persica*, *Acacia nilotica*, *Acacia Senegal*, *Acacia seyal*, *Leucas abyssinica*, *Hypostus auriculata*, *Becium grandiorum*, *Dobera glabra*, *Opuntia*, *Cordia sinensis*, *Aloe elegance*, *Bidens macroptera*, *Acacia pilispina*, etc. These floral species are not similar with floras in other areas of Ethiopia [13, 22, 33, 41, 44–48]. The plants bloom in different seasons of the year,

which assures a continuous supply of food for bees. This contributes to an increased frequency of harvesting.

During the group discussion, participants expressed that the availability of herbaceous floras was decreasing from time to time due to the recurrent drought and overgrazing due to increasing population. A similar result was reported by [33]. Bees store honey during the honey flow period for consumption during the no flower period. However, according to the respondents, there is a high utilization of honey by beekeepers. For this reason, bees face lack of food in dry periods.

Table 6. The honeybee flora of the study area

Species name	Life form	Flowering
Acacia mellifera	Shrub/Tree	October–December, May
Ziziphus spina-christi	Tree	September–December
Ziziphus mucronata	Tree	November–January
Ziziphus abyssinica	Tree	December–February
Acacia tortilis	Tree	April–June
Acacia senegal	Tree	May–July, October–December
Hypostus auriculata	Herb	July–November
Leucas abyssinica	Herb	August–October
Aloe elegance	Shrub	August–October
Becium grandiorum	Shrub	June–August
Opuntia spp	Shrub	May–July
Acacia etbaica	Tree	September–November
Euphorbia abyssinica	Tree	October–December
Acacia nilotica	Tree	April and June, September–November
Acacia seyal	Tree	May–June
Grewia ferruginea	Shrub	May–July
Grewia penicillata	Shrub	June–July
Grewia villosa	Shrub	May–July, September–November
Grewia bicolor	Shrub	May–July
Acacia pilispina	Tree	November–December
Balanites aegyptica	Tree	April–June
Acacia horrida	Tree	March–June
Salvadora persica	Shrub	March–April
Cordia sinensis	Tree	December–February
Bidens macroptera	Herb	August–September
Indigofera spinosa	Herb	August–September
Crotolaria incana	Herb	August–September
Tephrosia villosa	Herb	August–September
Tribulus terrestris	Herb	August–September
Ocimum lamifolium	Herb	August–September
Cynodon dactaylon	Herb	August–September

To overcome starvation during the period of flower scarcity, some beekeepers take different solutions such as supplementary feeding and migratory practices, taking them to areas with good sources of flowering plants, which is also supported by another study [31]. In the study area, 67.5% of the total respondents supplement their colonies during the dry period, from February to March. This result is supported by [25, 32, 46], while in the Guji and Borena zones of Oromia regional state only 37.67% of the respondents supplement their colonies [43]. The results were 100%, 63.7%, and 35% in Berahle, Dallol, and Koneba districts respectively. The type of feed they supplement were mainly sugar followed by roasted spiced bean flours (shuro). Beekeepers in Berahle also practised migratory beekeeping. They take their colonies to areas with better access to bee forage and water, mainly large mountains and irrigated areas. During group discussions, all beekeepers responded that they had inspected their colonies for disease and pests. They also practise certain treatments such as fumigation by some type of woody plant, such as olive, which are expected to have medicinal value.

Honey marketing

In this study, market information was defined as the awareness of people regarding where, how, when, for whom, and at what price honey is sold. Accordingly, 94% of the sample respondents gathered honey market information via people-to-people social information exchange system, which is locally called *Xaagu*. This information exchange system is highly powerful and allows the simple transmission of urgent information within a short period of time to a wider society.

As a result, pastoralists sold their pastoral products in the nearby market immediately after harvest to cover their production costs, social responsibilities, and direct family expenditures. The result shows that sample beekeepers were located at a distance between 2 and 16 km with an average distance of 7.4 km from their residence to the nearest market place (*Table 8*). The distance of the respondents from the nearest market centre measured either in minutes of walking or kilometres is one of the indicators of market accessibility. The above distance is shorter than the values observed in other parts of Northern Ethiopia [49].

In marketing, the surplus from the total produced commodities is more important; and market expansion has to be made for the surplus product. The rate at which pastoral production increases regulates the degree of pastoral livelihood improvement, whereas the growth in the marketable product determines the degree of economic improvement. The surplus product is the remained crop with the producer pastoralists after fulfilling their home consumption and payment requirements.

Table 7. Marketing information

Variables	Response	Koneba		Berahle		Dallol		Total	
		N	%	N	%	N	%	N	%
Marketing information	Yes	37	30.8	44	36.7	31	25.8	113	94.2
	No	3	2.5	0	0.0	4	3.3	7	5.8
Honey market participation	Yes	33	27.5	42	35.0	31	25.8	106	88.3
	No	7	5.8	2	1.7	5	4.2	14	11.7
Honey sales responsibility	Men	29	27.4	34	32.0	22	20.7	85	80.2
	Women	4	3.7	8	7.5	9	8.5	21	19.8
Market place accessibility	Farm gate	10	9.4	16	15.0	9	8.5	35	33.0
	Nearby market	23	21.7	26	24.5	22	20.7	71	67.0

N – Frequency, % – percentage

In essence, among the beekeeper respondents, 88% were involved in selling their raw honey surplus leftover, home-consumed by the family members and offered as gift for others. Due to the appreciable nature of honey regarding time, that is, the shelf-life of honey (which is longer than that of livestock products), beekeepers can sell it anywhere at any time to their customers. The amount of honey sold is also different from beekeeper to beekeeper due to the number of beehives, their colony-holding capacity, productivity per hive, and the amount of honey consumed at home and offered as gift to others. Accordingly, the sample beekeepers sold honey ranging from 0 Kg to 353 Kg, with a mean of 77.86 kg per year per household at a mean price between 150 ETB (7 USD) and 200 ETB (9 USD) per Kg over the study year (*Table 8*).

Table 8. Distance to market and the amount of marketed honey consumed

Variable	Koneba		Berahle		Dallol		Total	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Distance from market	4.53	1.11	10.27	4.52	7.14	4.32	7.42	4.37
Amount of honey sold per household	51.87	35.19	103.07	81.67	75.19	63.67	77.86	67.04
Price per kg	181.28	16.09	185.00	16.91	182.22	17.26	182.94	16.69
Consumed honey per household per year	14.77	10.45	6.98	7.54	12.08	10.72	11.08	10.05

Std. Dev. = standard deviation

The price of honey in the study area was more than 100% higher than the price in other areas of the country in the same year [21, 25, 29, 33, 50, 51]. The reason for the high price of honey in the area is due to the high-quality special honey owing to the floral species. Consumers can find a special honey from one or

two flowering plants, which can be purchased and consumed for a specific treatment. For example, people who need honey from *Ziziphus mucronata* can get it prepared only from *Ziziphus mucronata*, which is generally used as coughing medication.

Most of the producers sold their honey at the nearby market (67%), whereas 33% of them sold it at their farm gates. This result is in line with the report of [13, 50]. More duties related to honey selling fall to the men (80%) than the women (20%) (*Table 7*). On average, 11.08 kg of honey is either consumed within the household and/or given away to family relatives, which means about 12.5% of the produced honey was not supplied to the market. The percentage of honey sold is higher than that of reported in Arsi zone of Oromia region [13], where 45% of the honey produced was used for home consumption.

Major constraints of honey production

Nowadays, beekeepers are facing a number of difficulties and constraints that limit the efficiency of honey production. Respondents raised a number of constraints that hinder beekeeping in their area. The major challenges and constraints recognized in the target area are listed in *Table 9*. Poor extension service, enemies and disease, shortage of water, poor knowledge, and shortage of improved technology are the top-ranked constraints. The rank of constraints in the study area is different from constraints ranked in other parts of the country [21, 25, 45, 50, 52–54]. The difference might be due to the different agro-ecological characteristics and production system.

Table 9. Major beekeeping constraints in the study area

Constraints	Rank by frequency												Overall ranking
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	
Poor extension services	40	45	15	10	3	3	4						1st
Lack of knowledge	18	2	20	39	11	12	7	2	5		3	1	4th
Recurrent drought	1	1	5	16	15	33	20	10	6	6	4	3	6th
Deforestation	2	1	5	5	10	17	36	20	11	7	2	4	7th
Lack of improved technologies	7	2	15	20	38	15	5	5	1	5	3	4	5th
Poor infrastructures		1		5	11	12	22	40	13	7	9		8th
Pest, predators, and diseases	32	42	20	5	10	7	1	1	2				2nd
Chemical application		3		3		1	1		12	12	26	62	12th
Shortage of bee flora		1		2		2	8	10	23	45	14	15	10th
Lack of credit		1	7	5	7	11	13	17	35	15	4	5	9th
Market inaccessibility								11	10	21	55	23	11th
Shortage of water	20	21	33	10	15	7	3	4	2	2		3	3rd

Number of respondents – 120

Opportunities of beekeeping

There is large number of bee floral species in each season of the year in every location of the study area. The demand of hive products for domestic use and export market is constantly on the rise. Currently, government and non-government organizations largely support natural resource conservation programmes within which beekeeping is encouraged. A rich culture, a proper perception of the society of beekeeping, a favourable environment with a diverse agro-ecology, indigenous knowledge, a high interest in accepting improved beekeeping systems, and undertaking apiculture as a mainstay are just a few opportunities worth mentioning.

4. Conclusions

Honeybees are the second important assets available to most of the respondent beekeepers in North Afar. Beekeeping has many advantages that help the people of the area to improve their economic and nutritional requirements. The ownership of honeybees in the area is regarded as having a secured and healthy family. This is a good asset for the community to scale up the business. The relatively high number of colonies per household in the area, though all in traditional hives, is also an opportunity. More than half of the households start beekeeping by collecting wide colonies due to the lack of a systemic/organized supply of colonies on the market and a lack of community awareness regarding selling colonies.

None of the respondents have colonies in modern hives, which indicates that modern hives are not well promoted in the area due to the poor involvement of extension agents. This might be due to the less involvement of extension agents in supporting the beekeepers and training them in terms of strategies. The strategic model of assigning trained experts to deliver institutional services, and thereby adopt improved technologies, was not successful in the region. Therefore, beekeepers should be provided sufficient information on the drawbacks of traditional beekeeping and the benefits of modern apiculture, using community-based education. Moreover, this requires an intervention on the part of the government and other organizations – through practical trainings, extracting indigenous knowledge, etc. – to adopt improved beekeeping practices.

Due to the large number of special tropical plants found in the areas, harvesting frequency is higher than in most of the researched environments of the country. Despite the problems faced by the apiculture sector, there are a number of opportunities to improve this venture and to increase the outputs of the activity. This is important for a sustainable improvement of the community's life. Beekeepers should be capable of preparing their bee colonies for consecutive harvesting and the regular inspection and assurance of the colonies. According to the survey, the honey marketing system in the area was found to be traditional. The

producers do not profit from the marketing systems. Thus, honey producers should be organized into producers' cooperative societies. This would enable producers to manage the prices of products. Attention should be paid to diversification of hive products and added values. In the area, wax is not produced due to lack of awareness of the importance of the product and absence of processing equipment and technical abilities. Therefore, awareness should be created on the value of beeswax and other hive products. This may ensure proper benefit from the business.

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