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Research Article

The Status of Beekeeping in Simada District, Amhara, Ethiopia, with Its Challenges and Opportunities

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Abstract

The study was designed to assess the existing beekeeping practices, constraints, and potential of honeybee production in Simada district. The study was carried out in four proportionally selected kebeles of highland, midland, and lowland agro-ecology. Accordingly, a total sample size of 146 beekeepers, depending on their potential, was interviewed using a structured and semi-structured questionnaire. A semi-structured questionnaire, field observation, and focal group discussion were employed to collect primary data. Descriptive statistics such as mean, frequency, and standard deviation were used to analyze the data. The majority of beekeepers in the district are mail-headed, and the majority can read and write. Beekeepers practiced three hive types but mostly used traditional hives. The majority of honeybee colonies are found in midland agro-ecology, but they are not significantly different ($P<0.05$). About 57.5% of beekeepers obtain their colony through buying, and their colony increases through reproductive swarming. Beekeepers construct both traditional and top-bar hives from the surrounding available material. Frame hives were obtained from GOs on a credit basis. Beekeepers indicated that the majority of honey was harvested in October and November. The second minor harvesting period was from May to June, which depends on the nature of the yearly rainfall conditions. As the respondent's described, they stored honey below one year in a plastic jar, clay jar, and plastic sack when plenty of products were obtained and for medicinal value, unless they used honey during harvesting as a source of income. Predators and pests are major constraints on honey bee production, followed by pesticides and herbicides in the study area. Other identified beekeeping constraints were shown in relative order of importance: drought, death of colony, lack of water, migration, and disease are some of the problems that hinder productivity. Honeybees required feed supplementation during the dry season; about 28% of beekeepers fed their colonies with higher supplements made from February to April. The commonly used supplements were peas and bean flour (Shiro), barley flour (Besso), sugar, honey, and others, including Niger.

Keywords

Beekeeping Practice, Challenges, Honeybee, Opportunities and Simada District

1. Introduction

In Ethiopia, beekeeping is a long-standing agricultural practice [1]. Ethiopia is one of the countries with the longest tradition of beekeeping in the world. Many of the rural communities practiced it as a sideline activity for honey and

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wax production that contributes to income generation [2]. With this long tradition of beekeeping, the country gets an opportunity to supply honey and beeswax to international markets [3].

The country is estimated to have ten million honey bee colonies, which is the largest in Africa [4]. It is believed that more than half of the colony numbers are kept (hived) in three different hive types: traditional, top bar, and frame hives. Ethiopia is the top honey-producing country in Africa, one of the ten largest honey-producing countries in the world, and one of the four largest beeswax-producing countries, and this commodity is one of the major exportable products [5]. From this, the annual honey production of the country has been estimated to be 66,000 tons. About 96.3% of the total honey production is obtained from traditional hives. The honey produced from top bar and frame hives, respectively, is extremely low and constitutes 0.8% and 2.9% of total annual production in 2018. The overall national productivity for all hives is 10 kg/hive [6].

Even if the total production looks large enough, only a small amount of this product is delivered as an export market item. This is because the country itself has huge local market demand for the honey and beeswax produced. Accordingly, among its production, more than 70% is used for making a local beer called "Tej," and only 10% of the product is used as table honey [7]. Most of the time, households consume less than 10% of their total harvest at home, mainly for medicinal, ritual, or cultural ceremonies, and the remaining is available for the market. Beeswax is also used to produce candles for rural farmers', especially in Orthodox Tewahido churches. But productivity and honey production are not as expected due to various reasons [8].

Beekeeping is an accustomed practice in the farming communities of the Amhara region, and it plays a significant role as the source of additional cash income and nutrition for many subsistence farmers [9]. In the region, the apicultural resources are immense, particularly in the western parts of the region. The natural vegetation coverage is relatively high, the colony population is dense, and production is relatively high. Besides, the beekeeping potentiality of the region is partly attributed to the various cultivated oil crops, pulses, and field flowers, which are very important sources of forage [7].

The regional livestock resource development promotion agency is also giving more emphasis to the apiculture sector because of its multidirectional importance, like watershed management, employment of rural youths, and enhancing rural community incomes through honey and wax production increments. Since the promotion of frame hives and the introduction of innovations have been done for the last 15 years, several honey bee colonies have been transferred into the top bar and frame hive technologies [10].

The study area Simada is one of the north-eastern districts of the region. It is located in the South Gondar Zone. The area has relatively high potential for natural vegetation coverage, honey bee colony number, and honey production. Beekeeping practice in the district has been believed to have an important contribution to rural livelihood, such as poverty reduction and livelihood improvement through income generation. It is also important for the employment of landless youths in the district. Beekeeping is practiced in three types of hives: traditional, top bar, and frame hives.

Moreover, no investigation has been done on the presence and risk factors of honey bee production problems in selected sites in Simada district, South Gondar Zone, Amhara region, Northeastern Ethiopia, which gave input to the initiation of this study.

Objectives

1) To assess beekeeping practices in Simada District.
2) To identify major constraints and potentials of beekeeping in the study area.

2. Material and Methods

2.1. Description of the Study Area

The study was conducted in Simada District, which is located in Amhara National Regional State, 105 km from South Gondar Zone and about 770 km northwest of Addis Ababa, and bordered on the southeast by the Bashilo River, which separates it from South Wollo Zone; on the southwest by the Abay River, which separates it from East Gojjam Zone; on the west by East Este; on the north by Lay Gayint; and from northeast to southeast SedeMujja district. Part of the study district is bordered by Este and also touched by the Wanka River, which is a tributary of the Abay. The absolute location of the study area is at 11 °100"-11 °30' 0" N, latitude, and 38 ° 10' 0"-38 °20' 0" E, longitude.

The total population of the district is estimated to be 180,566 (97,010 males and 83,556 females); most of the total population are urban dwellers. The total area of the district is 133,394.03 ha; of this, 50,275 ha are cultivated land and 28,311.42 ha are grazing land. The remainder is covered by other conditions. The most common soil types in the study area are black soil (50%), red soil (20%), brown soil (20%), and gray soil (10%). The average landholding per household is estimated to be 0.25–1.5 ha [11].

The altitude extends from 1,202 to 3,287 meters above sea level. The district has a different topographical landscape, which is 40% undulation, 15% mountainous, 40% plain land, 3% gorge, and 2% water body. The average rainfall ranges from 1200 to 1800 mm, and it is represented by 4 agro-ecologies: Wurch (0.1%), highland (45.4%), midland (46.7%), and lowland (7.8%). The average annual temperature ranges from 10 to 25.

Livestock is an important component of the prevailing crop-livestock mixed farming systems in the study area. Smallholder farmers in the study area owned various livestock species, such as cattle, sheep, goats, poultry, and horses. The livestock population in the study district is estimated to be: cattle = 108298, sheep = 62690, goats = 88812, horses =

20694, and poultry = 78504. Beekeeping is also one of the activities practiced in the area. A total of 1,475 beekeepers are also estimated to own 14,148 honeybee colonies (12,891 in traditional hives, 237 in top bar hives, and 1020 in frame hives) [11].

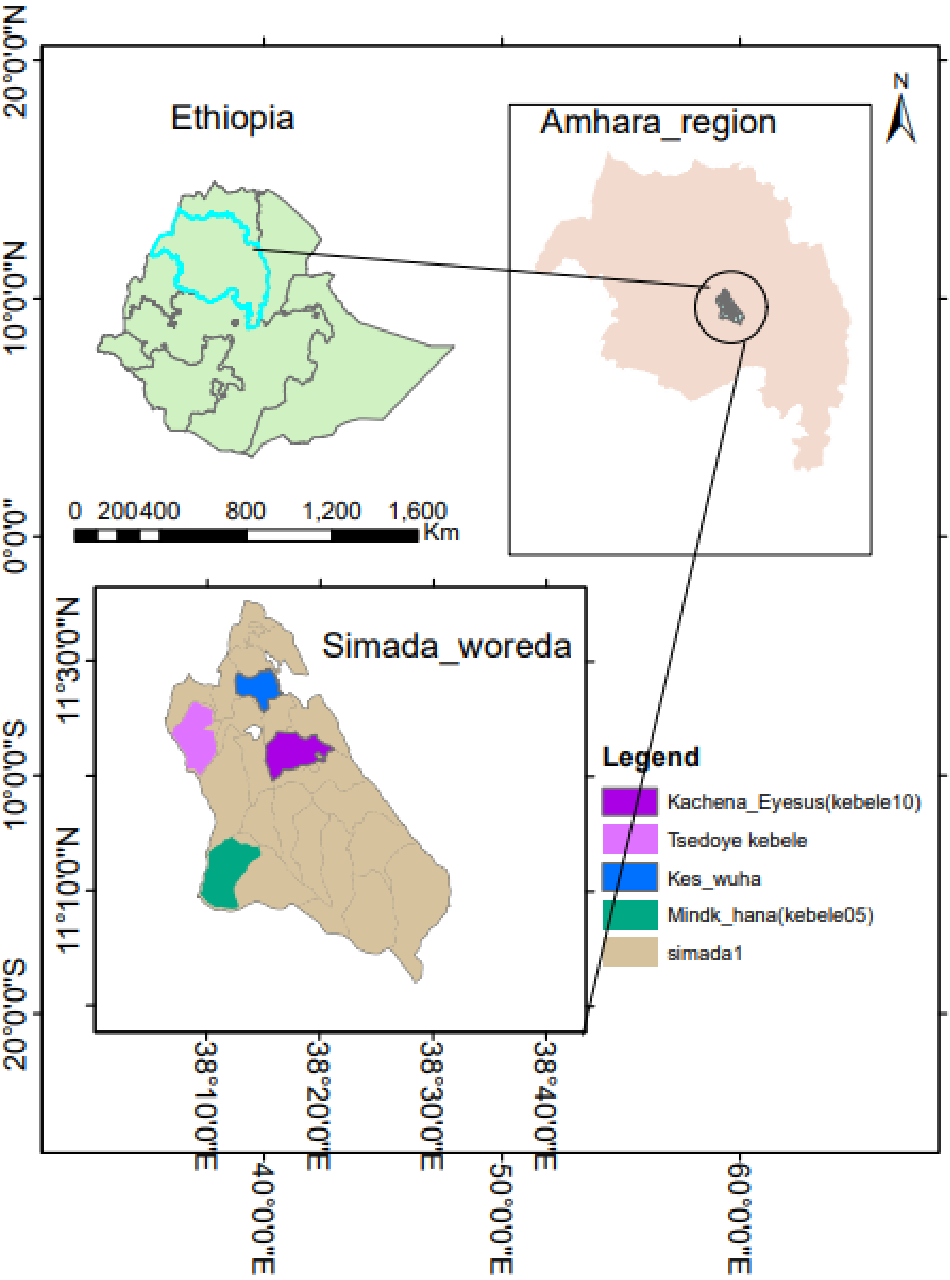

Figure 1. *Map of the study area.*

2.2. Sampling Technique and Sample Size

The study was conducted to assess the beekeeping practices in the study area. The area consists of a total of 26 rural and two urban dwellers in Kebeles. The district is stratified into highland, midland, and lowland (5, 14, and 7 rural Kebele's, respectively). A systematic random sampling procedure was followed to select the peasant associations based on the availability of beekeepers and their agro-ecological zone accordingly: four representative sample Kebeles, one from highland, two from midland, and one from lowland, were selected using proportional sampling techniques. A total of 146 respondents from the four Kebeles Kesewuha (39), Tsedoye (59), Kachena (25), and Mendikhana (23) samples were selected proportionally. The selection was made using a simple random sampling. The sample size was determined using Yamane's formula.

$$n = \frac{N}{1+N(e^2)}$$

Where; n= Sample size, N= Total population, e= Level of precision at 7% significant

2.3. Data Source and Methods of Collection

Data were collected from four Kebele's systematically based on agro-ecology representativeness and beekeeping potential. Both primary and secondary data sources were used to achieve the objectives of the study. Both qualitative and quantitative methods were used for primary data collection. Primary data was collected from sampled respondents, focus group discussions, interviews with key informants, and direct observations from each of the representative Kebles through a semi-structured questionnaire. Secondary data was collected from different published and unpublished sources, such as previous research findings, reports of the Ministry of Agriculture (MOA), the Regional Livestock Resource Development Promotion Agency, the district Livestock Resource Development Office, and other governmental and non-governmental organizations.

Before the actual survey, the questionnaires were pre-tested. The actual data collected during the survey work was included. Household characteristics: social: (sex, age, family size, education level, and economic status: land holding, livestock, honeybee colonies, off-farm activities) Beekeeping potential: number of hives owned, type of hives used, cost of hives, beekeeping types of equipment, active season and dearth period, amount of honey and crude beeswax harvested, cost of production of honey and crude beeswax, honey marketing situation, and market prices.

Farmer's indigenous knowledge and practices: landing of hives, hive inspection, methods of swarm control, swarm catching experiences, methods of colony multiplication, harvesting time and methods, honey storage facilities, and post-harvest management of honey.

Potentials and constraints of beekeeping in the study areas: vegetation cover, potential honey plants and flowering time, poisonous plants, water resource availability, honeybee pests and predators, insecticides, and other agro-chemical applications.

2.4. Data Analysis

The Collected data from both primary and secondary sources were documented, organized, analyzed, and summarized using excel and SPSS version 24 software. The survey data were coded and tabulated for analysis using SPSS statistical package version 24. Descriptive statistics such as means, standard deviation, frequency, and percentages were used to analyze the quantitative data using SPSS software.

3. Results

3.1. Socio-Economic Characteristics of Respondents

3.1.1. Household Characteristics

The study result indicated that about 95.2% of the total sampled households (146) were male-headed households, while about 4.8% of the sampled households were female-headed households, as shown in Table 1. This might be due to the lack of outlook of beekeepers because they believed that the activity was carried out by males.

Regarding marital status, about 91.1% of total interviewed households were married, while 0.7%, 7.5%, and 0.7% were single, widowed, and divorced, respectively (Table 1). This result shows that married participants in beekeeping practice were significantly higher than other marital-status households.

Table 1. *Sex, religion and marital status of respondents.*

Description	Variables	Frequency	%
Sex of respondents	Male	139	95.2
	Female	7	4.8
Marital Status	Married	133	91.1
	Single	1	0.7
	Widowed	11	7.5
	Divorced	1	0.7
Religion of household	Orthodox	145	99.3
	Muslim	1	0.7

About 58.9% of respondents have 4-6 family sizes in one household, and 33.6% of respondents recorded have 1-3 family sizes, while households with a family size greater than 6 were about 7.5% of the total respondents, as indicated in Table 2. The largest family size is more important for beekeeping practice as it is the source of labor and becomes more productive. As indicated in Table 2, from the total respondents, about 56.2% of households surveyed were able to read and write, 32.2% were illiterate, and the rest, 9.6%, 1.4%, and 0.7% of respondents were in grades 1–8, 9–12, and higher-level, respectively. The age of the majority of beekeepers (about 65.1%) in the study area ranges between 21 and 60 years, as indicated in Table 2. This indicates that the majority of beekeepers in the study area were under the productive and active age stage. It is important to actively participate and become productive.

Table 2. Family size, educational status, and age of beekeepers.

Description	Variable	Frequency	%
Family size	1-3	49	33.6
	4-6	86	58.9
	>6	11	7.5
Educational status	Illiterate	47	32.2
	Read and Write	82	56.2
	Grade 1-8	14	9.6
	Grade 9-12	2	1.4
	Higher-level	1	0.7
Age of beekeepers	15-20	4	2.7
	21-60	95	65.1
	Above 60	47	32.2

3.1.2. Landholding of Households

As described in Table 3, about 61.6% and 67.1% of the total respondent's total landholding and farmland, respectively, range from 1–1.5 ha. Specifically, 5.5% of respondents have farmlands larger than 1.5 ha. The majority of the respondents had grazing land <0.5 ha. This revealed that the grazing land owned by respondents is very small and inadequate to practice livestock production and bee forage development. So this hinders the productivity of bees and livestock. Generally, the average landholding is related to the national average (1.5 ha) landholding.

Table 3. Landholding of Households.

Description	Total landholding		Farm landholding		Forest landholding		Grazing landholding		Other land holding	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
<0.5ha	-	-	-	-	21	14.4	105	71.9	-	-
0.5-1ha	9	6.2	40	27.4	-	-	-	-	-	-
1-1.5ha	90	61.6	98	67.1	-	-	-	-	-	-
>1.5ha	47	32.2	8	5.5	-	-	-	-	-	-
Total	146	100	146	100	21	14.4	105	71.9	-	-

Freq. refers to frequency

3.1.3. Major Crops Grown and Production Constraints in the District

According to the survey results, different crops were grown in the study area. As shown in Figure 2, wheat, barley, potatoes, and beans are specially grown in high-land agro-ecology. While Teff, grass pea, Niger, and chickpea are in midland. In the lowlands, the most dominant crop is kidney beans. Respondents also indicated that most crop types are the main source of pollen and nectar, so seasonal crop productions are an important factor for seasonal honey production in the district, but not all crops are equally important for honey bees.

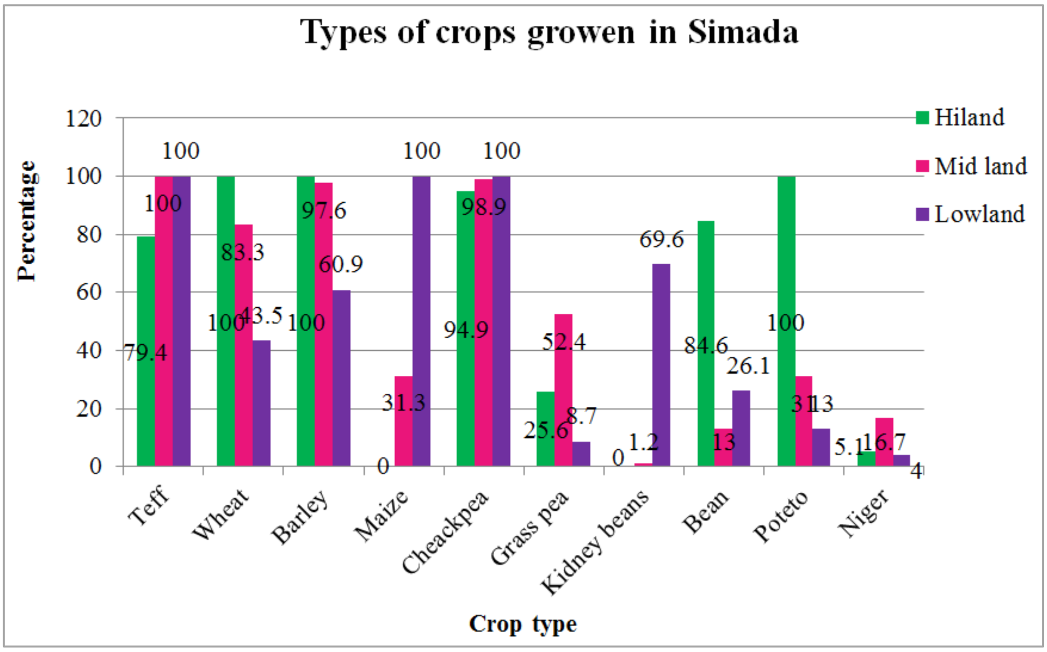

Figure 2. Different types of crops grown in Simada District at different agro-ecology.

3.2. Beekeeping Practice

3.2.1. Source of Honey Bee Colony and Hive Types

Based on the survey results, about 68.8% of traditional hives and 100% of top bar hives, respectively, were constructed by beekeepers themselves. While the rest, 25.7% and 5.6% of traditional hives were bought from surrounding beekeepers constructed locally and from markets at local prices, respectively. On the other hand, as shown in Table 4, all of the respondents had frame hives obtained from the government on a credit basis, as frame hives are not as easily constructed as traditional hives.

Table 4. Source of hives in Simada District.

Source of hive	Traditional hive		Top bar hive		frame hive	
	Frequency	%	Frequency	%	Frequency	%
Constructed by him/her self	99	68.8	13	100	-	-
Constructed locally and bought	37	25.7	-	-	-	-
Bought from market	8	5.6	-	-	-	-
Supplied by GO on credit base	-	-	-	-	36	100
Supplied by GO on free	-	-	-	-	-	-
Supplied by NGO on credit base	-	-	-	-	-	-
Supplied by NGO on free	-	-	-	-	-	-
Total	144	100	13	100	36	100

According to the survey results, about 18.5% and 24% of the respondents obtained their colony from parents and caught swarm colony during the swarming season, respectively. This indicates that swarming was a source of colony until this time. Even if the colony is obtained in different ways, the majority of respondents (57.5%) have reported that mostly their colony sources were buying (figure 3).

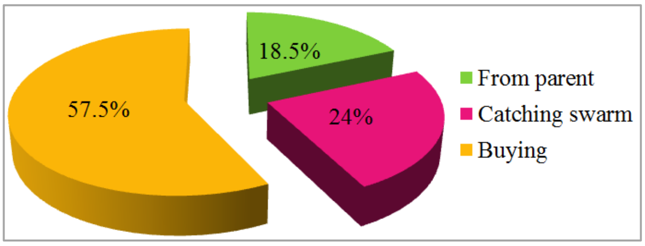

Figure 3. Sources of honey bee colony in household.

3.2.2. Types of Beehives Used in Beekeeping Practice

As the survey result shows, about 95.8% of the respondents managed traditional beehives, whereas only five beekeepers (4.2%) managed both three types of beehives for honey production. Beekeeping in the study area is taking place in three different production practices: traditional, top bar, and frame hives, with a grand mean of 7.3, 2.3, and 4.9 colonies per respondent, respectively, as described in Table 6. Most beekeepers in the district practice the traditional beekeeping system. Concerning agro-ecology, the average number of traditional hives in the highland, midland, and lowland of the district were 5.7±3.2, 8±6.4, and 7.8±6.7, respectively. While the top bar hive is 3±0, 2.4±1.2, and 1.5±0.7, the frame hive is also described in Table 5. Generally, as the result indicates, there were no significant differences between different hive-type colonies ($p<0.05$) in different agro ecologies.

Table 5. Types of bee hives and number of colonies owned by respondents.

Hive type	Agro-Ecology									Grand Mean
	Highland			Midland			Lowland			
	N	R	Mean ±SD	N	R	Mean ±SD	N	R	Mean ±SD	
Traditional hive	37	15	5.7±3.2	77	27	8.0±6.4	21	24	7.8±6.7	7.3
Top-bar hive	2	0	3.0±0.0	8	4	2.4±1.2	2	1	1.5±0.7	2.3
Frame hive	6	3	2.5±1.0	26	24	5.9±5.1	4	2	1.8±1.0	4.9

N= number of respondent; SD= Standard deviation from the mean; R= range

3.2.3. Beekeeping Experience and Hive Types of Respondents

The result showed that the mean prices of frame hives, top bar hives, and traditional hives were 750.0, 161.7, and 62.2, respectively (Table 6). The minimum and maximum price of traditional and top-bar hives indicate the quality of the hives. Nowadays, beekeepers are preparing top bar hives in two ways: one is to prepare all parts of the hive from bamboo, and the second is to construct the body from thin lumbering wood, and the top bar is made from wicker and lumbered wood. This product of hive is sold at a better price than bamboo types because it is strong and high in quality. Most respondents do not use frame hives, even if they want, due to their costliness. This is the one factor that retarded the expansion of frame hive technology until this time. As described in Table 6, both three types of hives—traditional hives, top bar hives, and frame hives—serve for 11, 12, and 16 years, respectively, if there is caution and best management, and the hive was made of good material and in good shape. Unless the hive is not satisfied with the above conditions, it serves for a short time because of sun, rain, wind, and other management factors.

Table 6. Price, service year of hive types, and beekeeping experience of respondents.

Description	N	Minimum	Maximum	Mean ±SD
Price of Traditional hive	143	30	100	62.2±19.2
Price of Top bar hive	12	120	200	161.7±33.0
Price of frame hive	36	700	800	750.0±12.0
Service year of Traditional hive	142	5	11	7.9±1.5
Service year of Top bar hive	12	4	12	8.8±3.1

Description	N	Minimum	Maximum	Mean ±SD
Service year of frame hive	36	8	16	10.5±2.2
Beekeeping experience of respondents	146	3	54	17.8±10.6

N= Number of respondents; SD= Standard deviation from the mean

3.2.4. Trends of Honeybee Production in the Last Five Years

As described in Figure 4, the development of beekeeping in three hive types was at a minimal level. The number of colonies kept in the top bar hive, frame hive, and traditional hive found in the study area has undergone little growth over the last five years, from 2016 to 2020. The average number of bee colonies for the traditional, top bar, and frame hives was about 991.8, 18.2, and 142.4, respectively. While the average annual increment was 11.75, 3, and 22.5 colonies, respectively, over the last 5 years (Figure 4), The number of traditional hives from 2016–2017 increased by 136, but starting from 2017–2020, it slightly decreased for 4 years, as shown in graphical expiration (Figure 4). This may be due to the poor management activity of beekeepers. While the number of top bars and frame hives was increased to a minimum,. This indicates the acceptability of modern beekeeping activity with regard to beekeepers. Therefore, facilitating basic training is important for beekeepers and extension agents to easily understand the technology for its best adoption and upgrading in the sector.

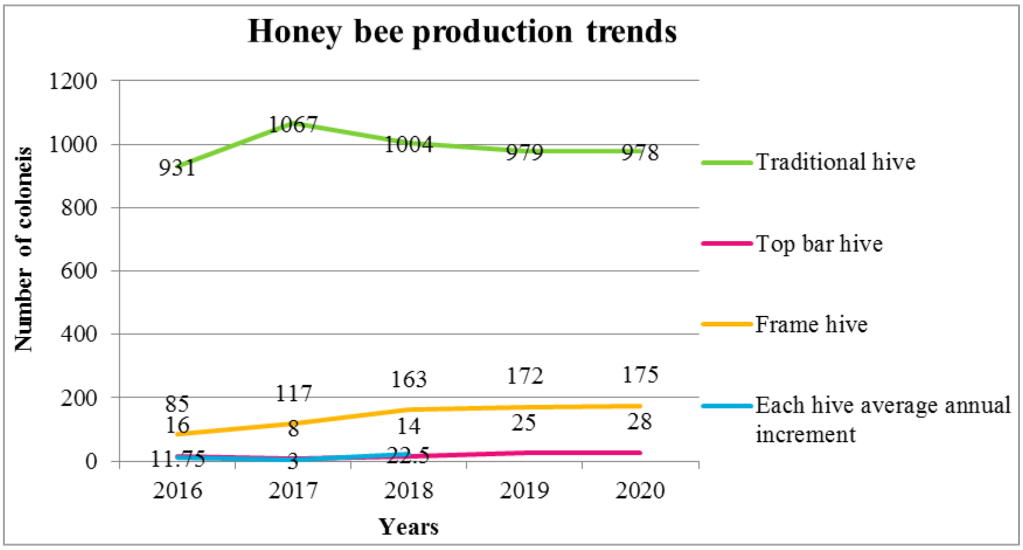

Figure 3. Trends of honeybee production in Simada District in the last 5 years.

3.2.5. Advantage and Disadvantage of Different Hive Types

The survey result shows that traditional hive beekeeping practice has advantages as it is 100% easily constructed by beekeepers from locally available materials. Table 8. This type of beehive didn't require improved technologies and materials; rather, beekeepers used their knowledge and local materials. Due to the availability of materials, traditional hives in the district were obtained at a substantial cost. As a result, the respondents reported that they were 100% cost-effective. The disadvantages of traditional hives were a lower honey quality yield (77.1%), increased swarming (100%), and, as compared to frame hives, 36.1% of respondents indicated traditional hives are not suitable to harvest when the comb is constructed vertically along with the hive.

Top bar hive beekeeping practice also has advantages as it is made with locally available materials (100%). As indicated in Table 8, all of the respondents reported that the top bar hive is less coasty as compared to the frame hive in Simada District. Regarding its durability, most respondents (66.7%) have responded as durable. Generally, the durability of the hive depended on the constructed materials and handling system. As described in Table 1, reproductive swarming is high in the top bar hive (100%). On the other hand, the disadvantage of top bar hives, according to the respondents (66.7%), was that they were not suitable to harvest due to the inappropriate construction of top bar sizes. Most of the top bars constructed from bamboo resulted in inappropriate comb construction, breakdown, and damage to the colony during harvesting, and less quality honey was harvested as compared to frame hives (Table 7).

According to the respondent's result, the frame hive beekeeping practice was important for the suitability of harvesting honey (97.3%), producing quality honey (100%), and the durability of the hive (94.6%). Besides, frame hives minimize swarming (89.2%) when using proper management and supporting the supper box and queen excluder at the right time. Unless, as 10.8% of respondents indicated, swarming occurs in normal conditions (Table 7). The disadvantage of a frame hive is its high price, inability to be constructed from locally available materials (100%) by beekeepers, and inability to harvest (2.7%) if the most required types of machinery, equipment, and well-skilled personnel were not fulfilled as compared to the traditional hive.

Table 7. *Relative preference of beekeepers (%) for the three hive types.*

Description	Traditional hive		Top bar hive		Frame hive	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Material availability	100.0	-	100.0	-	-	100.0
Suitable to harvest	63.9	36.1	33.3	66.7	97.3	2.7
Quality honey harvest	22.9	77.1	25.0	75.0	100.0	-
Hive durability	95.1	4.9	66.7	33.3	94.6	5.4
Cost-effectiveness	100.0	-	100.0	-	-	100.0
Minimize swarm	-	100.0	-	100.0	89.2	10.8

3.2.6. Honey Bee Eco-types and Aggressiveness

Based on their indigenous knowledge, beekeepers have their own methods of categorizing their honeybees based on the color of the honeybees. About 42.5% of respondents described their local honey bees as black and 39% as grey-colored. The remaining 18.5% of beekeepers have mixed black and gray-colored honeybees. Beekeepers are also familiar with the physical appearance and temperament of local honeybees, and they are reported as having a black colony that is mostly large and aggressive. The majority of respondents (87.7%) also describe a gray-colored colony as having less defensive behavior with its medium and small body size. As described in Table 8, both gray and black-colored eco-types occur together in the same colonies. This might be due to the fact that the queen may be mated with drones that come from different hives with varied colors.

Table 8. *Behaviors of honey bee colony in the study area.*

Local name	Aggressiveness				Size of honeybee		
	Aggressive	**Aggressive**	**Docile**	**Both aggressive & docile**	**Big**	**Medium**	**Small**
Black	12.9	79.0	1.6	6.5	80.6	19.4	-
Grey	-	3.5	87.7	8.8	-	77.2	22.8
Mixed	11.1	-	-	88.9	7.4	92.6	

3.2.7. Empty Hives and Hive Placement

According to the survey results shown, the maximum number of empty hives (traditional hive, top bar hive, and frame hive) was found in the midland beekeeping area (Table 9), but in highland and lowland, the minimum. The empty top bar hive was not found in the lowland area. This indicates the utilization of top bar hives in Lowland was very poor. While the expansion of both hive types in the midland area is better as compared to the highland and lowland agro-ecologies of the district.

Empty hives were owned for several reasons, based on the survey result 26.7% of respondents indicated that absconding was the main cause for owning empty hives. On the other hand about, 71.9% of respondents informed that they store empty hive for reserves. While the rest interviewee 1.4% responded as empty hives were owned due to other cases like the death of the colony (Table 10).

Table 9*. Empty hives in Simada District.*

Hive type	Highland				Midland				Lowland			
	N	Min	Max	Mean ±SD	N	Min	Max	Mean ±SD	N	Min	Max	Mean ±SD
Traditional hive	39	1	8	3.3±1.7	83	1	20	4.3±3.5	22	1	12	5.3±3.7
Top bar hive	2	1	1	1±0.0	5	1	3	1.4±0.9		-	-	-
Frame hive	3	1	1	1±0.0	19	1	5	1.8±1.1	3	1	3	1.7±1.2

N=number of respondents, Min= minimum, Max= maximum, SD= standard deviation

Table 10*. Reasons for empty hive.*

Reasons for empty hive	Frequency	%
Absconding	39	26.7
Reserve	105	71.9
Other cases	2	1.4
Total	146	100.0

According to respondents' responses, most beekeepers keep their traditional, top bar, and frame hive bee colonies in their backyards and near wall placement. The back yard apiary site is mostly fenced to protect the colony from wind, animals, and other factors. As shown in Table 13, backyard hive placement accounts for 76.3%, 83.3%, and 88.9% in traditional, top bar, and frame hives, respectively, while near-wall hive placement accounts for 23.7%, 16.7%, and 11.1%, respectively (Table 11).

Table 11*. Proportion of hive placement in the study area practiced by Beekeepers.*

Hive placement	Traditional		Top bar		Frame	
	Frequency	%	Frequency	%	Frequency	%
Backyard	103	76.3	10	83.3	32	88.9
Near the wall	32	23.7	2	16.7	4	11.1
Total	135	100.0	12	100.0	36	100.0

Figure 4. *Photos which indicates beekeepers how they placed their hive.*

Table 12. *Hive inspection activity of beekeepers in Simada District.*

Inspection frequency	Types of inspection	
	External inspection (%)	Internal inspection (%)
Frequently	65.8	-
Sometimes	34.2	39.7
Rarely	-	60.3

3.2.8. Hive Inspection and Seasonal Activities

Based on the responses from the beekeepers, they inspect their colony both externally and internally. As described in Table 12, about 65.8% and 34.2% of respondents inspect their colony externally frequently and sometimes, respectively. While internally, 60.3% of respondents inspect rarely and 39.7% of respondents inspect sometimes. External inspection is a simple and appropriate inspection practice that can be done at any time. During this inspection, respondents understand the foraging activity of the colony, hive placement, inflow and outflow of bees, enemies on the body of the hive (ants, spiders, lizards, birds, etc.), and the general healthiness of the apiary site. While in internal inspection, respondents observe the internal conditions like the condition of the queen, comb construction, the enemies that entered the hive, disease, and other factors, but they reported that farmers don't commonly practice internal hive inspection due to the difficulty of fixed combs attached to the body of traditional beehives and a lack of awareness.

Honey bees have a common phenomenon in the colony, such as reproductive swarming, absconding, and brood rearing. Depending on honey flow and dearth period seasons, honey bees perform their normal activity. According to the survey results, several beekeeping activities are practiced in different seasons. As shown in Table 13, beekeepers have frame hive (100%) supper, adding season starting from the 3rd week of August to September. While 63.9% of respondents who had frame hives reduced their super during February to April. February to April is dearth season in the district. During this season, beekeepers reduce the super for the survivability of the colony. In the study area, there are two honey harvesting periods: the main honey harvesting period is from

October to November, while the second minor harvesting period, which depends on the nature of the yearly rainfall condition, is from May to June. Based on the respondent's response, colony transfer was practiced between August and October, specifically from the end of August up to the last week of September. A minimum number of beekeepers have indicated absconding (13%) and colony feeding (2.4%) were practiced between August and October, but the majority of absconding (78.1%) and colony feeding (97.6%) were done in the dearth period of February–April, when scarcity of honeybee forage occurs.

Of 28% of beekeepers practiced feeding supplementary feeds to their colonies in different seasons: 2.4% in August to October and 97.6% in February to April. But the rest of the respondents didn't feed the colony. The supplementary feed available in the locality is peas and bean flour (Shiro), barley flour (Besso), sugar, honey, and others, including Niger. These are mostly used by beekeepers in Simada district during the dearth period for supplementation. Feeding of supplementary feed in the dearth period makes the colony active for the active period.

Table 13. *Seasonal activity of honey bees and beekeeping management.*

Activities	Seasons							
	Aug-Oct		Nov-Jan		Feb-Apr		May- Jul	
	F	%	F	%	F	%	F	%
Adding a supper	36	100	-	-	-	-	-	-
First round honey harvesting	79	54	67	46	-	-	-	-
Second round honey harvesting	-	-	-	-	-	-	146	54.1
Supper reducing	-	-	-	-	23	63.9	-	-
Absconding	19	13	-	-	114	78.1	13	8.9
Swarming	146	100	-	-	-	-	-	-
Colony transfer	146	100	-	-	-	-		
Colony feeding	1	2.4			40	97.6	-	-

F= frequency

3.2.9. Swarming Tendency and Controlling Technique

Reproductive swarming is accepted by most beekeepers. But as shown in Table 14, about 81.5% of respondents reported that their colony was actively reproduced. While the rest, 18.5% of respondents, responded that their colony did not give birth to a reproductive swarm. This may be due to different management activities between beekeepers. Good management is important for reproduction, but in the district, beekeepers don't practice it for the purpose of colony reproduction unless they simply catch it during the colony reproductive swarming season.

Beekeepers in the district practiced several techniques to catch the reproductive swarms leaving their apiary site. As described in Table 16, the majority of respondents (87.7%) use smoke to calm swarming colonies. On the other hand, 2.1% and 81.5% of beekeepers apply dust and water, respectively, when the swarm is flying in the air, and 28.5% of respondents use the technique of hanging a hive on a tree branch (Table 14).

The swarming of honeybee colonies was utilitarian for the majority of respondents. As described in Table 14, about 88.4% of respondents reported that their colony increases through reproductive swarming, while 9.6% and 2.1% of respondents use it as a source of income by selling reproductive swarm colonies and replacing none, respectively. Even if reproductive swarming is advantageous, several respondents indicated its limitations. During the time of swarming, honey yield was reduced (76.7%), the colonies were exposed to starvation (13%), and other factors (10.3%). In this case, beekeepers develop a mechanism to control swarming, such as increasing hive size by removing the queen cell and adding a supper box. From the total beekeepers (13%) of respondents who control swarming, removing queen cells (78.9%), increasing hive size (5.3%), and beekeepers that have frame hives use supper boxes (15.8%) (Table 14).

Table 14. Swarm catching practices.

Description	Techniques	Frequency	%
Swarm catching techniques	Using dust	3	2.1
	Using water	119	81.5
	Hanging hive on three branches	42	28.8
	Smoking	128	87.7
Swarm controlling method (N=19)	Increasing hive size	1	5.3
	Removing queen cell	15	78.9
	Super box	3	15.8
Advantage of swarming	Increasing number of colony	129	88.4
	To sell and income source	14	9.6
	To replace none reproductive colony	3	2.1
Disadvantage of swarming	Loss of honey yield	112	76.7
	Exposed to starvation	19	13.0
	Other factors	15	10.3

3.3. Hive Products and Honey Productivity

As shown in Table 15, all of the respondents harvest only honey and beeswax. Basically, the other most important hive products, such as bee venom, bee brood, royal jelly, pollen, and propolis, were not known by beekeepers in the district. This may be due to a lack of knowledge and harvesting equipment; it may also be a lack of awareness due to the presence of very poor and restricted extension services in relation to hive product harvesting, processing techniques, and usage.

Table 15. Awareness of beekeepers for different types of hive products.

Types of hive product	yes %	no%
Honey	100	-
Wax	59.6	40.4
Bee venom	-	100
Bee brood	-	100
Royal jelly	-	100
Pollen	-	100
Propolis	-	100

The honey production in the study area varied from year to year. The average annual production from traditional hives was 4,090.9 kg, with a 5-year average annual increment of 105.1 kg. (Figure 6) While in the top bar and frame hive, the average annual production in 5 years was 127.3 kg and 2633.4 kg, with an average annual increment of 27.7 kg and 493.1 kg, respectively. The total production of honey in the study district was ineffective (Figure 6). Less growth in honey yield indicates a low level of colony management, a change in vegetation coverage, and a low adoption of technology. Generally, the production of honey is characterized by fluctuating growth in traditional and top bar hives and slightly upward growth in frame hives. As described in Figure 6, the traditional hive from 2016–2017 indicates an upward flow, but from 2017–2018, it slightly decreased, and after 2018, the rest of the years increased. While in the top bar hive, starting from 2016–2017 and 2019–2020 indicates a slowdown, from 2017–2019 it partly increases. Generally, the total production from the three hives shows upward movement year to year.

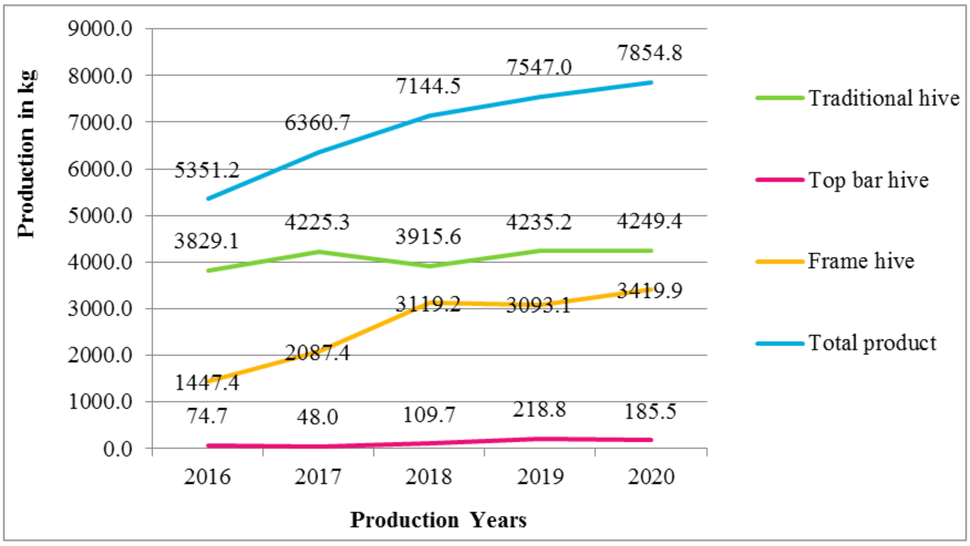

Figure 5. Honey production trends of respondents in Simada District.

Based on the respondent's information, the productivity of the colony varies year to year. Hence, the average annual production per hive of traditional, top bar, and frame hives was 4.1 kg, 6.8 kg, and 18.3 kg, respectively (Figure 7). While the average annual increment per hive is 0.1 kg, 0.5 kg, and 0.6 kg, respectively. In traditional hive per hive production slightly decreased (2016–2018) but slightly increased (2018–2019), while in top bar hives, the production of honey per hive in 2020 was significantly lower than in 2019 by 2.2 kg/hive.

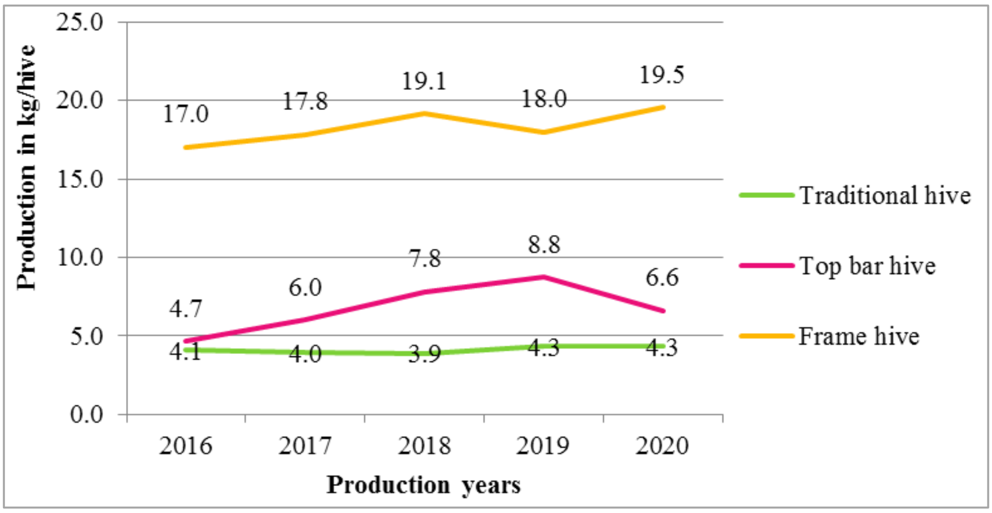

Figure 6. *Average honey Production per hive in Simada District in the last 5 years record.*

3.3.1. Honey Storage Duration and Containers Used

Local beekeepers used different honey storage materials with different storage durations. About 91.1% of respondents use plastic jars. 2.1% use clay pots, and 6.8% of respondents use plastic sacks to store honey, respectively (Table 16). The most commonly used material was a plastic jar. The food-grade plastic container was the ideal storage material for the quality of honey. But the clay jar may cause moisture loss and suck a bad smell from the atmosphere due to the hygroscopic nature of honey.

Farmers store honey when plenty of products are obtained, unless beekeepers use honey during harvesting. Most of the time, beekeepers store honey for medicinal value when production is low. As shown in Table 16, about 89% of the respondents reported selling their honey in a short period of time. But 4.1% of respondents store for about 1-2 years due to fluctuation of the price and different purposes, like a reserve for medicinal value. On the other hand, 6.8% of respondents didn't store at any time; they would sell immediately after harvesting.

Table 14. *Honey storage duration and handling container.*

Description		F	%
Honey storage duration	<1 year	130	89
	1-2 year	6	4.1
	Didn't store	10	6.8
Honey storage container	Plastic jar	133	91.1
	Clay jar	3	2.1
	Plastic sack	10	6.8

F =frequency

3.3.2. Honey Quality Identification at Household Level

Based on the respondent's endogenous knowledge, they use color as a quality identification parameter. In addition to color, the test and thickness of honey were also used. About 84.2% of respondents use color as a major quality identification parameter, while 11.6% and 4.1% of beekeepers identify through the thickness and test of honey (Figure 8). Producers grade their honey for sale based on personal evaluation, but there were no given standards for quality differentiation. The color of honey also determines the utilization of honey (medicinal, tej-making, market price, etc.). Regarding the price of honey, white and yellow honey fetch the highest price in the district.

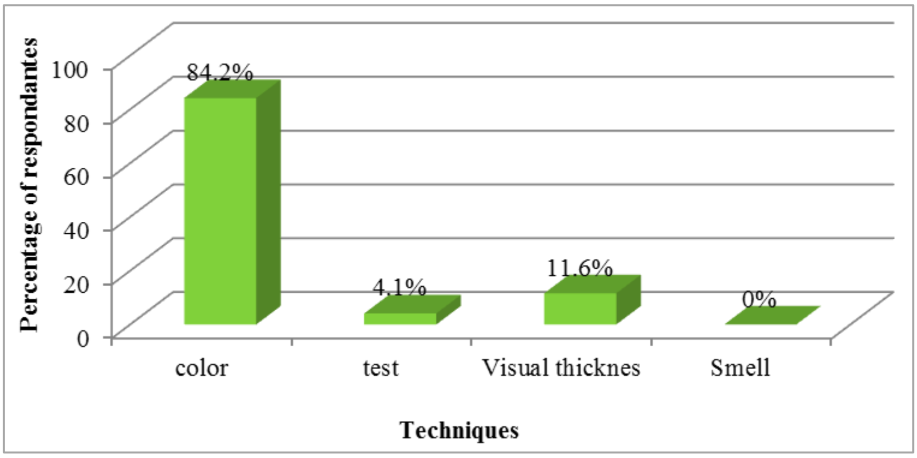

Figure 8. *Possible techniques for honey quality identification via sense organs.*

3.3.3. Honey Use and Marketing

According to the results obtained from the interview, about 97.3%, 95.9%, and 29.5% of respondents harvest honey for the purpose of marketing, medicine, and food (Figure 9). While 4.1% of respondents from the total interviewed persons didn't use honey for medicinal purposes, In the study area, the majority of beekeepers use honey for income sources, but 2.7% of respondents didn't harvest surplus honey for marketing purposes other than home consumption. Most of the time in the district, honey is consumed during harvesting time, but the maximum number of beekeepers, about 70.5%, don't use honey as a common food.

Honey produced by beekeepers is directly sold at local markets (80.8%); moreover, 15.1% of respondents sell their products to collectors. On the other hand, some of the respondents (4.1%) didn't sell surplus products; rather, they were used for home consumption. Generally, in the district, there is no alternative market accessible; there are no market information sources about the seasonal price and place of the products to be sold. Actually, it is very necessary to feed those beekeepers to gain a fair price at the correct marketing time. The maximum price of strained and unstrained honey was 250 and 200 birr/kg, respectively. While strained and unstrained honey sold for 200 and 150 birr at a minimum. As shown in Table 19, even if strained honey is more preferable in the district, the percentage of unstrained honey production was higher due to a lack of knowledge and a lack of extracting material.

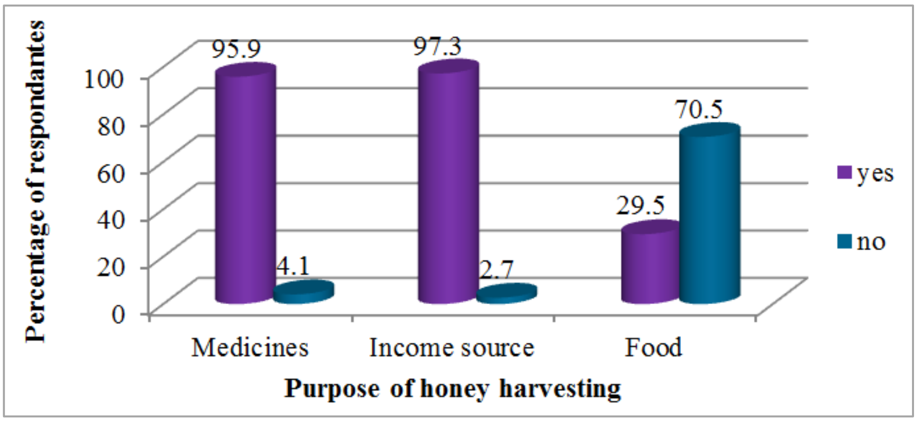

Figure 9. *Purpose of honey harvesting in Simada District.*

3.3.4. Reasons for Unprocessed Honey

Based on the survey results, about 64.4%, 16.6%, and 16.6% of respondent beekeepers didn't strain honey due to a lack of material, a lack of knowledge, and both a lack of knowledge and materials. But the rest, 1.7% of respondents', describe that extraction cases extravagancy of honey (Figure 10). However, the straining of honey separates the honey from beeswax and other unwanted materials, which are sold separately. The honey, as well as the wax, had a better price than unstrained honey. It requires awareness creation and efficient follow-up for producers to repeatedly adopt the techniques.

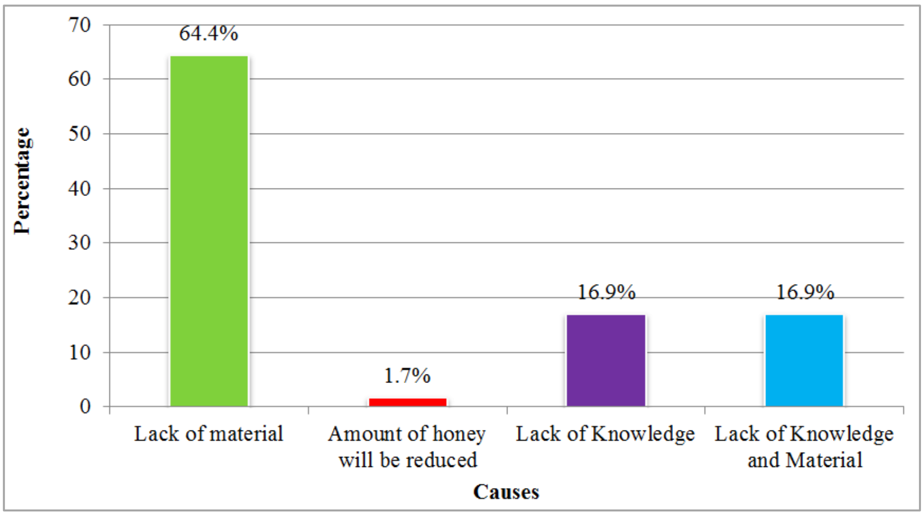

Figure 70. *Reasons for no practicing of processed honey in the District.*

3.4. Potential of Beekeeping in Simada District

The Availability of Important Honey Bee Flora Species

Beekeeping is a more ecologically suitable area than any other livestock production. According to the respondent's information, several plant species were recognized as major honey bee forage sources. The major honey bee forage sources found in the district were cultivated crop types and field plant species. The major crop types grown in the district are maze (*Zeamays*), oil seeds of nut (*Guizotia abyssinia*), gomenezer (*Brassica spp.*), veg (*Lathyrus sativa*), cheack pea (*Cicer artietinum*), and lentil (*Lens culiaris*) while the major plant species are Acacia spp., *Eucalyptus globules, and Cordia Africana,* as listed in Table 20.

Figure 11. *Some of the honey bee forage plants in the study area.*

Table 15. *Major bee forage plants and their flowering season in Simada District.*

Local name	Scientific name	Plant type	Agroecology	Flowering season
Abalo	*Combretum collinum Freesen*	Tree	Lowland	
Adey abeba	*Biden spp*	Herb	Both land	August-September
Agam	*Carissa spinarum*	Shrub	Midland	May-June
Atat	*Maytenus arbutifolif/ obscura*	Shrub	High/midland	
Ater	*Pisum sativum*	Crop	High/midland	August- September
Azoharege	*Clematis hirusta*	Herb	Kola/midland	September-December
Bakela	*Vicia faba*	Crop	High/midland	August- September
Bissana	*Croton macrostachyus*	Tree	Mid/highland	March-May
Boleke	*Phaseolus vulgaris L*	Crop	Low/midland	August
Chebha	*Acacia nilotica*	Shrub	Lowland	November-December
Chiret	*Agave spp*	Shrub	Both land	May-June
Denech	*Solanum tubersum*	Crop	High/midland	July-August
Digita	*Sennasiamea*	Shrub	Lowland	October-December
Embacho	*Rumex nervosus*	Shrub	Both land	August-September
Endode	*Phytolacca dodecandra*	Shrub	High/midland	December-March
Eret	*Aloe vera*	Shrub	Midland	September-December
Gaja sare	*Unidentified grass spp*.	Herb	High/midland	August-October
Gerar	*Acacia species*	Tree	High/midland	January-march
Gomenzer	*Brassica carinata*	Vegetable	Mid/highland	August-September
Grawa	*Vernonia amygdalina*	Shrub	Mid land	December-March
Kega	*Rosa abyssinica*	Shrub	High/midland	February-May
Kencheb	*Euphorbia tirucalli*	Shrub	Lowland	January-March
Kentefa	*Entada abyssinica*	Shrub	Low/midland	January-March
Key beharzaf	*Eucalyptus spp*	Tree	Mid/low land	March-June
Kitkita	*Dadonaea viscose*	Shrub	Lowland	Septamber-october
Kulkual	*Euphorbia abyssinica*	Shrub	Midland	May-June
Kusheshle	*Echinopes sp*	Shrub	High/midland	September-November
Maget	*Trifolium steudneri/acaule*	Herb	High/midland	September-October
Mech	*Guizotia scabra*	Herb	Both land	September-November
Nech beharzaf	*Eucalyptus globule*	Tree	Mid/hi land	March-June
Nuge	*Guizotia abyssinica*	Crop	Mid/highland	September-October
Sasebaniya	*Sesbania sesban*	Shrub	Midland	November-January
Shembera	*Cicer arietium*	Crop	Mid/low land	November
Shenkurte	*Allium cepa*	Vegetable	Mid/highland	-
Shisha	*Boscia anguistifolia*	Tree	Lowland	-
Simiza	Justitia schemperina	Shrub	Midland	-
Telba	*Linum vsitatissiumum*	Crop	High/mid land	September-October

Local name	Scientific name	Plant type	Agroecology	Flowering season
Tosign	*Thymus schimperi*	Shrub	Highland	July-September
Yemeno guwaya	*Vicia dassycarpa*	Shrub	High/midland	August-September
Wajema	*Medicago polymorpha*	Herb	High/midland	August-September
Wanza	*Cordia Africana*	Tree	Mid-land	October-November
Weyra	*Olea Africana*	Tree	High/midland	March-April
Worka	*Ficus vasta*	Tree	Midland	April

W= white, Y= yellow, B= Black, R= Red

Table 16. *List of highly visited floras by honey bees.*

Plant type	Frequency	%
Abalo (Combretum collinum Freesen)	3	2.1
Adey Abeba *(Biden spp)*	56	38.4
Gerawa (*Vernonia amygdalina*)	2	1.4
Maget *(Trifolium steudneri/acaule)*	13	8.9
Much (*Guizotia scabra)*	3	2.1
Nuge (*Guizotia abyssinica)*	60	41.1
Kega *(Rosa abyssinica)*	7	4.8
Wanza (Cordia Africana)	2	1.4

3.5. Major Constraints of Honey Bee

3.5.1. Pest and Predators

Honeybees have different constraints. As shown in Table 19, most of the respondents believed that pests and predators were the number one beekeeping constraint, followed by pesticides and herbicides in the district. Most of the time, people depend on crop cultivation and farming practices; in this case, farmers use chemicals to reduce the effects of pests and herbs. A majority of respondents described the prevalence of pests and predators as the second most important problem that affects honey bees, both in terms of productivity and quality of hive products. Thirdly, absconding was assigned by respondents as one of the most important factors that affect honey bees. It may be caused by pests, predators, pesticides, and herbicides. Fourthly, bee forage was described by respondents. It depends on the seasonal condition of the rainfall; it is mainly affected by drought as well as other agricultural activities. Other identified beekeeping constraints were shown in relative order of importance. Drought, death of colony, lack of water, migration, and disease are some of the problems that hinder the productivity of honey bees in the district.

Table 17. *Major constraints of honey bee in Simada District.*

Constraints of honey bee	Index	Index in %	Rank
pest and predator	0.178	17.8	1
pesticide and herbicide	0.171	17.1	2
Absconding	0.136	13.6	3
Lack of bee forage	0.122	12.2	4

Constraints of honey bee	Index	Index in %	Rank
Drought	0.107	10.7	5
Death of colony	0.101	10.1	6
Lack of water	0.098	9.8	7
Migration	0.052	5.2	8
Disease	0.034	3.4	9

Index = sum of (9*ranked1st+8* ranked2nd+7*ranked3rd………..+1*ranked 9th) for each individual reason, divided each individual index by the sum of total index.

As shown in Table 20, beekeepers reflected that the most important enemies of honey bees in the district were bee-eater birds (100%), ants (93.85%), and spiders (75.5%). Bee-eater birds are the most dominant factor, mostly occurring from March to June. The rest—bee lice (43.2%), honey badger (40.4%), lizard (37%), wax moths (34.2%), wasps (21.9%), snakes (9.6%), and beetles (2.1%)—affected honey bees sequentially.

Table 18. Major enemies of honeybee and their occurrence with their preventive measure (N=146).

Enemies of honeybee	Index	Index in %	Rank	Season of occurrence	Prevention measure
Bird	0.158	15.8	1	Marc- June	Keeping by wonchif, killing
Ant	0.154	15.4	2	Year-round	Cleaning the apiary, using ash,
Spider	0.118	11.8	3	Year-round	Cleaning, the apiary, removing the wear of the spider, killing the spider
Wax moth	0.106	10.6	4	May-September	Fumigating with cotton cloth
Bee lice	0.101	10.1	5	Year-round	Half prevention with smoke, separate the infected colony
Honey badger	0.094	9.4	6	Year-round	Capture by trap, killing, using dogs
Wasp	0.080	8.0	7	May-June	Capture and kill the wasp
Lizard	0.075	7.5	8	Year-round	Killing, smoking around the hive
Toad	0.052	5.2	9	May-September	Cleaning the apiary, killing the toads
Snake	0.041	4.1	10	Year-round	Killing, smoking
Beetle	0.023	2.3	11		

Index=sum of (11*rank1st+10*rank2nd+9*rank3rd……… +1*rank11th) then for each reason, each index divided by the sum of all index.

3.5.2. Unwise Use of Agro-Chemicals

Based on the survey results, the majority (66.4%) of farmers used chemicals for weed control. While 26.1% applied chemicals for crop pest control. In addition to this, minimum interviewee use for malaria control (2.1%) is described in Figure 12. Nowadays, various types of pesticides, insecticides, and herbicides are used without consideration of the damage to honeybee colonies. Mostly: 2-4-D, palas 45-odd, crop star for weed control, and best, carotin, Dimatot, Diasenol, Malatine (50%), Savin, and Agrolambasi for insects were used in the district.

As respondents describe, among herbicides, 2-4-D were highly stringent chemicals for the honey bees. Colonies that received direct spray finally failed due to 2-4-D contamination. Even though adult bees were not immediately killed and no adult dead bees were observed in colonies, the removal of eggs, larvae, and sealed brood led to the eventual collapse and failure of the effected colonies. Beekeepers understand the effect of chemicals on honeybee life. They have noticed that chemically affected colonies died inside the hive at the foraging area, even though they did not return to the home when the disease was the disease was very severe. Indirectly, it has also affected the forage source plants, which exposed the bees to starvation.

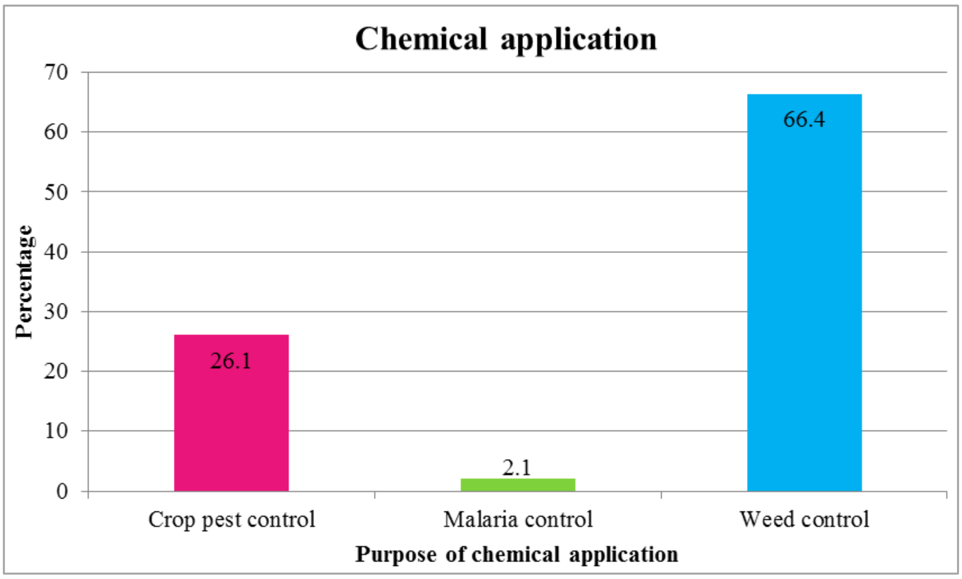

Figure 12. *Purpose of chemical application in the District.*

Respondents used different mechanisms to protect bees from chemicals. The common mechanisms, such as avoiding using chemicals around apiary sit (30.8%), using chemical early morning (11%), and late evening (25.3%), and the most important common technique is using chemicals before the flowering stage of plants (32.9%); applying agro-chemicals that have a residual hazard to bees in the late evening, after the bees have stopped foraging, is the best way to protect honey bees from the effects caused by pesticides and herbicides.

3.5.3. The Existence of Poisonous Plants

According to the research results, bees were poisoned while foraging poisonous plants. As shown in Table 21, *Clematis hirusta* (2.1%), *Croton macrostachyus* (32.2%), *Euphorbia abussinica* (4.8%), and *Eucalyptus spp.* (2.1%) were the most common poisonous honey bee plants in the district. These plants cause weakness as well as the death of colonies. Such plants's honey has also poisoned humans, such as *Eucalyptus spp.* (2.7%), *Agave spp.* (25.3%), *Euphorbia triucalli*, *Eucalyptus spp.*, and *Justitia schemperina* (0.7%, 3.4%, and 15.8%, respectively). The nectar or pollen of poisonous plants is toxic to the bees themselves, and the honey produced from their nectar is toxic to humans.

Table 19. *Poisonous plants for honey bee and human.*

Description	Plant type	F	%	Symptoms and Cause
Poisonous plants for honeybee	Clematis hirusta	3	2.1	Weakness,
	Croton macrostachyus	47	32.2	Diarrhea, Weakness, and death of the colony
	Euphorbia abyssinica	7	4.8	Death of bees, Sickness of bees
	Eucalyptus spp	3	2.1	Weakness, death of bees, loss of the colony
Poisonous plant's honey for human	*Eucalyptus spp*	4	2.7	Bitter to humans, cause disease
	Agave spp	37	25.3	Bitter to humans, cause disease
	Euphorbia tirucalli	1	0.7	Bitter to humans, cause disease
	Euphorbia abyssinica	5	3.4	Vomiting, nausea, case diseases on
	Justitia schemperina	23	15.8	Sickness, nausea, vomiting, of consuming persons

F= frequency

4. Discussion

About 95.2% of the total sampled households (146) were male-headed households. This means that beekeeping has been considered an activity carried out by men. It was also reported that reported that 89% of beekeepers in Sekota district were men. Generally, a small number of females were participating in beekeeping practices in the study area. [12]. This might be due to the lack of the lack of outlook of beekeepers because they believed that the activity was carried out by males. Regarding marital status, about 91.1% of the total the total interviewed households were married. While the rest were single, widowed, and, divorced, respectively. As indicated by [13], married participants in beekeeping practice were significantly higher than other marital status households. As beekeeping requires labor, it is mostly carried out by married, households, and they are they are used in different ways for asset building. So, married beekeepers became more effective than other marital--status beekeepers.

The majority of beekeepers in the study area can read and write. Beekeeping requires literate and skilled man manpower because literate beekeepers can easily adopt innovative beekeeping technologies, provide technologies, provide extension services, properly handle the product, and also easily manage their colonies. Moreover, for illiterate people, there is a need for intensive training and persuasion of beekeepers before distributing innovative beekeeping technologies [14]. The majority of the respondents in the study area ranged between the ages of21 and 21 and 60 years under the productive and active age stage. It is important to actively participate and become productive. This result was similar to the finding of [2], who reported that the majority the majority of beekeepers in Siltie district were between 21 and 50 years old.

The majority of beekeepers in the study area construct their traditional and top bar hives themselves using locally available materials. While frame hives are hives are not as not as easily constructed as traditional hives, they are obtained from the government on a credit basis. This result is in line with the findings of [15] in the Waghimara zone, where 83.4% and 7.7% of beekeepers constructed traditional and top bar beehives, respectively. While 35.4% of beekeepers got frame beehives from the government the government with credit, others bought hives from local markets, and they got them got them from NGOs and GO's on both credit and free credit. About 57.5% of beekeepers buy their colony from surrounding beekeepers, while the rest obtain from parents and caching during swarming. The finding was in line with [7], who reported that the sources the sources of the foundation the foundation colony in Burie District were catching swarms, followed by buying, gifting, gifting, training and the agricultural the agricultural office. Most beekeepers practiced traditional production systems in the district. Similarly, the expansion of frame hives is in an inferior stage because of weak extension service, the initial cost of hives, a lack of seasonal management, a lack of equipment, a lack of knowledge about how to improve technology, and other factors that hinder frame hive growth in the district. This result was in line with the study of [16] in Gozamen District, East Gojjam Zone. Who described that the adoption of top bar hive technology is in an infant stage due to a lack of awareness and the minimum extension service being more dominant than traditional hives?

As the finding indicates, beekeepers categorize their colony as black or grey, and using their indigenous knowledge, most of them manage a black-colored colony [17]. The majority of beekeepers manage their colonies in their backyards and near the wall placement production system in the district. This black-colored honey bee was highly aggressive and large in size. In Gamo Gofa Zone some beekeepers kept traditional bee hives in the back yard of the house, followed by hives kept inside a simple shed built for hive placement, and hives kept under the eaves of the house [18]. Beekeepers inspect their colonies both internally and externally, but the frequency of external inspection was frequent while internal inspection was rare. During inspection, beekeepers understand several seasonal activities like reproductive swarming, absconding, and brood rearing. Beekeepers in the study area had experience with feed supplementation during the dry season. Commonly used supplements in the study area include sugar, roasted spiced pulse flour (shiro), and barely flour (besso). This is in line with the report by [3]. Who stated that during the dearth period, when there was little honey bee forage, beekeepers provided supplementary feeds, shiro and besso?

The major hive products in the district were honey, followed by wax. Basically, the other most important hive products, such as bee venom, bee brood, royal jelly, pollen, and propolis, were not known by beekeepers. This result is in line with [2], who reported that the common hive products in Siltie district were honey, bee wax, and honey bee colonies. The frequency of harvesting honey varied depending on the season; during the rainy season, honey was harvested twice per year in both hive types with medium-white color. The average annual production of honey varies year to year in traditional, top bar, and framed hives, even though there is slightly upward growth in framed hives. Honey was stored in the district for a long period of time in plastic jars and clay pots. About 91.1% of beekeepers stored their honey in plastic jars for the purpose of medicinal value when production was low. Similarly beekeepers for honey storage and transportation used both plastic bags and fertilizer bags [16].

Beekeeping is more ecologically suitable for an area than any other livestock production. According to the respondent's information, several plant species were recognized as major honey bee forage sources. The major honey bee forage sources found in the district were cultivated crop types and field plant species. The major crop types grown in the district are Maze *(Zeamays), Oilseeds of Nuge (Guizotia Abyssinia), Gomenezer (Brassica spp.),* Pulses of *Vetch (Lathyrus Sativa), Cheack Pea (Cicer artietinum),* and *Lentil (Lens culiaris),* while the major plant species are *Acacia spp., Eucalyptus globules,* and *Cordia Africana*. But all plants are not equally important as honey bees. From the majority of plants grown, honey bees highly visit selective floral plants. Based on the respondents' information, as indicated, *Biden spp., Guizotia abyssinica, Trifolium steudneri/acaule, Rosa abyssinica, Guizotia scabra,* and *Combretum collinum Freesen* were the most important amiable floral source plants. This result was related to [19] as they reported the floral phonology and pollen potential of honey bee plants in north-east dry land areas of the Amhara region. The availability of more seasonal bee forages in the district results in high honey production. But based on the respondents information, a shortage of bee forage occurred during the dry season due to the decline of bee forage compared to past vegetation coverage. This indicates deforestation and degradation were slightly increased year to year in the district. In some beekeepers, to minimize the shortage of honey bee forages, protection and conservation of natural vegetation and plantation of bee forage in farm boundaries and homesteads using multipurpose bee forage species were practiced.

Respondents noted that pests and predators rank first in beekeeping constraints, followed by pesticides and herbicides in the district. Bee-eater bird's ants and spiders are the most important enemies of honey bees in the district. Most of the enemies, such as ants, snakes, spiders, and lizards, damage the colony year-round, but beekeepers prevent this through cleaning the apiary, smoking, killing, and the application of ash around the hive. This is in line with [20] around Gondar, reported as the prevalence of pests and predators is interesting to the life of bees. Ants, honey badgers, bee-eater birds, wax moths, spiders, termites, and snakes cause devastating damage to honeybee colonies and products within a short period of time.

Most of the time, people depend on crop cultivation and farming practices; in this case, farmers use chemicals to control weeds and pests. Sometimes used for malaria control. It was reported that all respondents (100%) in Diga and WayuTuka Districts, East Wollega Zone, used chemicals [1]. The majority of the respondents used weed control and crop pest control. As respondents describe, among herbicides, 2-4-D were highly stringent chemicals for the honey bees. Colonies that received direct spray finally failed due to 2-4-D contamination. Even though adult bees were not immediately killed and no adult dead bees were observed in colonies, the removal of eggs, larvae, and sealed brood led to the eventual collapse and failure of the effected colonies. In Wallace Ville Animal Research Centre describes 2-4-D poisoning as having occurred via the nectar [21]. But it was not determined whether poisoning was due to an unchanged hormone dissolved in the nectar, a toxic metabolite of 2,4-D secreted into the nectar, or a toxin arising from abnormal plant metabolism. Most beekeepers in the district used different mechanisms to prevent bees from using chemicals, avoiding using chemicals around apiary sits, using chemical early in the in the morning and late in the in the evening, and the most common technique is using chemicals before the flowering stage of plants.

A majority of respondents described the prevalence of pests and predators as the second most important problem that affects honey bees, both in terms of productivity and quality of hive products. Thirdly, absconding was assigned by respondents as one of the most important factors that affect honey bees. It may be caused by pests, predators, pesticides, and herbicides. Seasonally, depending on the rain fall, forage was the constraint of honey bee production. Similarly, [22] reported a shortage of bee forage, agrochemical poisoning, and honeybee pests, which were also reported as major beekeeping constraints in Amhara regional state. Many beekeepers start to apply plantations of trees to superseded plants during the dearth period and supply survival feeds. Other identified beekeeping constraints were shown in relative order of importance. Drought, death of colony, lack of water, migration, and disease are some of the problems that hinder the productivity of honey bees in the district.

Bees also hindered their production, which poisoned plants. *Croton macrostachyus* is the major poison plant in the district. Also, the honey products of Agave spp. are poisoned for human consumption. Assemu Tesfa et al. (2013). Reportedly, the major honeybee floras known for their poisonous effects were *Croton macrostachyus, Eucalyptus spp., Euphorbia abussinica, Justitia schemperina,* and *Acacia decurrence.*

5. Conclusion and Recommendations

This research work took place on selected four kebeles of Simada district South Gondar Zone of Amhara region with the objectives of examining beekeeping practice, constraints, opportunity and quality of produced honey in the district. Generally three types of, (Traditional, Top bar, and frame) hive beekeeping practice were practiced in the district. However, the majority of beekeepers in the study area did not use improved beekeeping technologies instead, they practiced traditionally. Most beekeepers practiced different beekeeping activities like colony inspection, feeding, watering, swarming and colony transferring in different season.

The most known hive products in the District were honey and wax, while the rest products were not known. The amount of honey harvested varies from hive to hive and year to year due to the management activity of beekeepers, lack, and less reception of technology, and environmental condition of the district.

The major constraints they hinder the potential of beekeeping activity in the district were chemical poisoning, lack of bee forage, drought, absconding, and lack of water were reported by beekeepers. In addition to those Birds, ants, Spiders, Wax moth, Bee lice, honey Badger, Wasps and Lizards were the major honeybee pests and predators in order of their importance. Because of those factors particularly beekeepers do not benefited from the subsector. Despite all the constraints, and challenges currently the district has opportunity and potentials to maximize the production and quality of honey in the District.

Based on the sample laboratory result the district honey quality is comparable from National and International honey quality standard. Based on the results of this study, the following recommendations are forwarded for improving beekeeping practice and the Quality of honey in the study areas. Therefore based on the result of the present study the following recommendation is recommended. Hence

1) Women should be encouraged to participate in modern beekeeping through availing supports like training, credit services and modern beekeeping technologies by GOs, financial institutions and NGOs.
2) As Simada has a huge potential for beekeeping, therefore, governmental and nongovernmental organizations should work together in this subsector to change the life of rural people and to gain mutual benefit from beekeeping.
3) Provision of continues trainings on different, hive construction, hive inspection times, and post harvesting and handling method should be facilitated.
4) Governments should formulate chemical application rules and regulations and beekeepers should know the pollination effect of honey bee and avoid unwisely use of chemicals around the apiary site.
5) Except honey and wax other hive products, pollen, propolis, royal jelly, and bee venom, are not known by beekeepers, so a lot of incomes are wasted. Regarding to those products special attention should be given, and harvesting materials should present.
6) In order to prevent pest and predators, clearing apiary site and conducting continuous hive inspection is important.
7) Beekeepers should take prudence and avoid unwisely harvesting, processing, and storage of hive products.

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Author Contributions

Tadesse Tsegaw: Conceptualization, Project administration, Writing – original draft

Tessema Ayenalem: Methodology, Supervision

Agazhe Tsegaye: Formal Analysis, Software

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Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Conflicts of Interest

The authors declare no conflicts of interest.

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