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Original Research

Assessment of Honey Production Practices in Toke Kutaye District, West Shewa Zone, Oromia Regional State, Ethiopia

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Abstract

The purpose of this research was to examine honey production in the Toke-Kutaye district from a practical perspective, looking for both opportunities and significant limitations. From six kebeles in the district, 180 families were chosen at random based on the availability and potential for honey production. We gathered data through questionnaire surveys, focus groups, and field observations, and we analyzed it using a social science statistical software. Almost all of the honey producers in the area under consideration were men (97.8%), with just a small percentage being female (2.2%). In the region under consideration, the conventional honey producing method predominated. Hive to hive, even within the same agroecologies, the honey harvesting frequency varied. The study area had a number of limitations, including the use of insecticides, pesticides, and herbicides; insufficient beekeeping and safety equipment; and limited access to extension services. Rich bee feed, year-round water sources, and trustworthy indigenous knowledge of bee production were some of the key potential for honey production that were discovered in the research area.

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INTRODUCTION

Beekeeping is one of the most common agricultural activities in the world. It was reported that there are about 56 million Original Research beehives in the world, and 1.2 million tonnes of honey are produced from them (Ademuwagun, 2021). Ethiopia produces 54,000 metric tons of hohoney each year, accounting for about 24% of African production and costing around 620 million Birr (Bareke & Addi, 2020; Robi et al., 2023). Beekeeping has a long history in Ethiopia, and apicultural resources are immense, particularly in the western parts of the country. The western part of Ethiopia is thought to offer a diverse range of vegetation and cultivated crops, and beekeeping could be one of the primary intervention areas to alleviate food insecurity (Tadesse & Itefa, 2020). Rural apiculture can be practiced as an additional source of income for farmers in rural areas and has been successfully implemented in poverty-alleviating projects. In such

circumstances, beekeeping is often promoted in the context of rural development, as the practice provides monetary, nutritional, and social benefits to poor families without requiring land ownership or large amounts of capital investment (Kumar *et al.*, 2018). Based on the technological advancement of beekeeping practices, there are three different types of beekeeping practices in Ethiopia: traditional forest and backyard beekeeping systems, transitional systems of beekeeping, and frame hive/modern beekeeping systems (Tekle, 2018).

There are a lot of opportunities and constraints for beekeeping in Ethiopia. It was reported that the opportunities for beekeeping were the existence of honeybee colonies, the availability of potential natural forests with adequate apiculture flora, sources of water for bees, beekeepers experiences, the availability of interest among beekeepers to accept new technology and practices, the socio-economic values of honey, and the high demand for honeybee products (Goshme & Ayele , 2020). However, honey bee diseases, chemicals applied, the presence of pests and predators, a lack of credit service for the beekeeping sector, the high cost and limited availability of modern beekeeping equipment and accessories, frequent absconding, and the migration of bee colonies are the major constraints to beekeeping sector development in Ethiopia (Gratzer et al., 2021). Toke Kutaye district of West Shewa Zone has a diverse range of natural crops and vegetation suitable for beekeeping and honey production. However, there was no study conducted and documented specifically across the agroecologies of Toke-Kutaye district. Therefore, the current study was aimed at evaluating honey production practices and identifying opportunities and constraints in Toke Kutaye district.

MATERIALS AND METHODS

Description of the study area

The map of the research area is depicted in Figure 1. Toke Kutaye District is situated 126 km west of Addis Ababa, Ethiopia's capital. The district comprised 23 rural and 4 urban kebeles (the smallest administrative structure in Ethiopia).

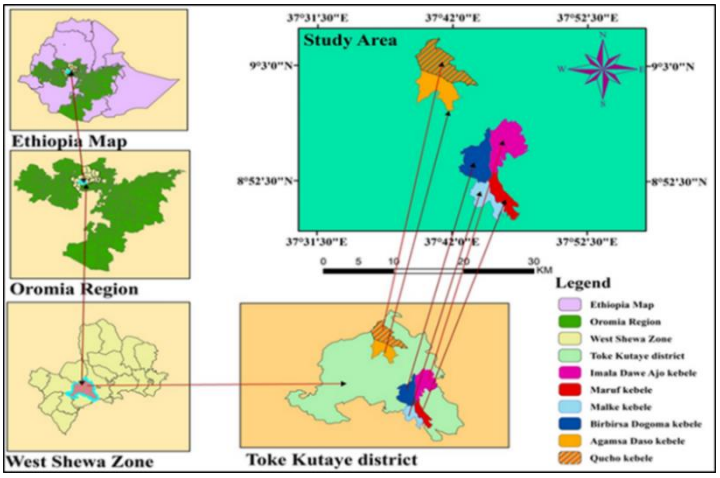

Figure 1. *Map of the study area*

The district's latitude is 8° 52' 27" north and its longitude is 37° 48' 23" east, with an elevation range of 1580 to 3144 metres above sea level. The district has three distinct agro-ecologies: lowland, which accounts for 18%, midland, which covers 25%, and highland, which covers about 57% (TKADO, 2020).(ArcGIS, 2022)

Sampling Method and Sample Size Determination

The research study area and respondent sample size are presented in Table 1. The study area was divided into three agro-ecological zones (lowland, mid-land, and highland) to select the '*kebeles'*. A total of 180 beekeepers were identified randomly from the target population. Lottery method sampling was used to select 52, 59, and 69 households from high, mid, and lowland agro-ecologies, respectively, based on the population of beekeepers in the study area. The total number of beekeepers in the research area was calculated using the Cochran (1977) formula with a 95 percent confidence level.

Table 1

Research study area and Respondents' sample size

Study District	Agro ecologies	Kebele	Total number of beekeeper's head	Sample size	Total number of beekeepers per agro ecology
	High land	Malke	340	28	52
Toke		Maruf	290	24	
Kutaye		Imala-Dawe ajo	360	30	59
	Mid land	Birbisa Dogoma	340	29	
		Agamsa Daso	420	34	69
	Lowland	Qucho	400	35	
Total	3	6	2150	180	180

Data Sources

The study utilised both primary and secondary sources to gather information. We collected primary data by conducting face-to-face interviews with selected households using semi-structured questionnaires. These questionnaires covered various aspects of beekeeping, including demographic information about the beekeepers (such as gender, age, family size, and education level) and information about their beekeeping practices. The primary data also captured details about honeybee production systems, the number of beekeepers, sources of colonies and beehives, types of beehives used, management of beehives, honey harvesting, yield, and the opportunities and challenges associated with beekeeping in the study area. In addition to conducting interviews, we also obtained primary data through key informant interviews, focus groups, and observation.

Secondary data was collected from various sources such as previous research findings, journals, the internet, reports from the Ministry of Agriculture and Rural Development (MoARD) at various levels,

reports from government organisations (GOs) and non-government organisations (NGOs) at different levels, reports from the Central Statistics Agency (CSA), and other published and unpublished materials. The secondary data served to complement the primary data.

Data collection techniques

The study employed questionnaires with both closed-ended and open-ended, semi-structured questions to collect data. We created and revised the questionnaires based on the pre-test results to ensure the validity, consistency, and clarity of the study objectives. We conducted a pre-test survey to gather background data on the research areas prior to the formal survey. We shaped the official survey questionnaires based on the pre-test survey findings. We administered questionnaires to the selected respondents in order to collect data. We discovered that conducting questionnaire interviews with the sample families was crucial because some of them might not be literate enough to complete the questionnaire.

Statistical Data Analysis and Management

The Statistical Package for Social Sciences (SPSS) spread sheet, version 24, processed, examined, and categorised the collected data based on agroecologies. The quantitative data analysis included the use of descriptive statistics like mean, standard error, percentage, and crosstabs to present the data. We also computed an index data analysis to rank the study results accordingly.

Sample size determination model used:

$$\mathrm{No} = \frac{\mathrm{Z}^2\mathrm{pq}}{\mathrm{e}^2} \quad (1)$$

$$No = \frac{(1.96)^2 0.15(1-0.15)}{0.05^2} = 196 \quad (2)$$

But, for a finite population, less than 10,000 Cochran developed the formula to reduce sample size,

$$n = \frac{\mathrm{no}}{1+\frac{\mathrm{no}}{\mathrm{N}}} \quad (3)$$

$$n = \frac{196}{1+\frac{196}{2150}} = 180 \quad (4)$$

RESULTS AND DISCUSSION

Beekeeping Practices

Individuals of various ages and genders performed beekeeping in the study area, using various methods to increase bee colonies as listed in Table 2. The highest mean value (1 ± 0) of a traditional beehive was obtained in the lowlands due to a lack of training, good extension services, and modern beehives and equipment. The lowest mean value (0.95 ± 0.03) of a traditional beehive was obtained in the midlands. However, the midlands had a higher availability of intermediate or transitional beehives compared to the traditional ones. The midlands had the highest mean value (0.31 ± 0.03) of movable beehives, indicating that modern beekeeping practices are more commonly practiced there than in the highlands or lowlands. The midlands, where beekeepers have access to modern hives and receive awareness about modern beekeeping equipment from NGOs and government organisations, produce the highest amount of honey.

Table 2

Types of beekeeping activities in the Study area

Types of hives	Agro ecologies				
	Highland	Midland	Lowland	Overall mean	*P - value*
		Mean ± SE			
Traditional	0.96 ± 0.27	0.9 5 ± 0.03	1.00 ± 0	0.97 ± 0.01	ns
Intermediate	0.02 ± 0.019	0.02 ± 0.017	0.00 ± 0.00	0.01 ± 0.01	ns
Modern	0.19 ± 0.05	0.31 ± 0.03	0.06 ± 0.03	0.18 ± 0 .29	**

Ownership of beehives

Table 3 presents the ownership of beehives in the study area. According to the results presented in Table 3, the majority of beekeepers (respondents) own traditional bee hives. Out of 180 beekeepers interviewed, about 148 (82.22%) of households possessing traditional beehives followed transitional beekeeping practices. In the present study, only 3 (1.66%) households owned modern movable beehives; 27 (15%) owned both traditional and modern beehives, whereas 2 (1.11%) owned both transitional and modern beehives.

Table 3

Type of honeybee hive owned by households

Description	Categories	Number of beekeepers	Percentage (%)
Types of hive	Traditional only	148	82.22
	Modern only	3	1.66
	Traditional and Modern	27	15
	Modern and Transitional	2	1.11
	Total	180	100

The number of hives owned per household

Table 4 displays the varying numbers of beehives bought by beekeepers during different periods of the year. The three different types of beehives were traditional, transitional, and modern beehives, in differing numbers. The mean values of traditional, transitional, and frame beehives per household were 4.04 ± 0.25, 0.01 ± 0.008, and 0.14 ± 0.27, respectively

Table 4

The minimum and maximum number of hives owned per households

Type of hive	Minimum	Maximum	Mean ± SE
Traditional bee hive	0	20	4.04 ± 0.25
Transitional bee hive	0	1	0.01 ± 0.008
Modern bee hive	0	4	0.14 ± 0.27

Placement of Beehives and Bee Colonies

As presented in Table 5, beekeepers reported putting their beehives and bee colonies wherever they wanted, such as on the roof of their house, their back yard, or hanging on the tree closest to their house. Accordingly, all beekeepers with traditional, intermediate, transitional, and movable beehives placed their beehives wherever they wished. Then, among highlands beekeepers, 38 (21.11%) kept their colonies under the eaves of their homes and other houses, 12 (6.67%) in the backyard, 2% hung on trees near the homestead, and 35 (19.44%) of beekeepers in the midlands kept their bees mostly in traditional beehives under their house eaves, 20 (11.11%) in their backyards, and 4 (2.22%) on trees near their homesteads. However, they only place movable and transitional beehives and colonies in their backyards. Similar to beekeepers in the study area's highlands and midlands, those living in the lowlands prioritized their beehives and colonies. So, about 57 (31.6%), 7 (3.89%), and 5 (2.78%) of those beekeepers placed their beehives and bee colonies under the eaves of their houses, in their backyards, and hanging from trees near homesteads, respectively.

Table 5

Bee hive and bee colonies setting sites in the study area

Placement of bee colonies	Agro ecologies			total
	Highland	Midland	Lowland	
Under eave of house	38(21.11%)	35(19.44%)	57(31.6%)	130(72.2%)
Backyard	12(6.67%)	20(11.11%)	7(3.89%)	39(21.66%)
Hanging on trees near homestead	2(1.11%)	4(2.22%)	5(2.78%)	11(6.11%)

Beekeeping experience

We considered the duration of beekeepers' active engagement in beekeeping to indicate their level of experience. Consequently, each beekeeper interviewed in the study area possessed a distinct beekeeping history. As shown in Table 6, the range of experience was 2 years to 34 years, with a mean of 13.58 ± 0.52 years.

Table 6

Respondent's beekeeping experiences in years

Variables	Agro ecology			Over all mean	*p- value*
	High land	Midland	Lowland		
Maximum	30	34	32	34	
Minimum	2	2	2	2	
Range	2-30	2-34	2-32	2-34	*0.104*
Mean ± SE	11.96 ± 0.82	13.71± 0.95	14.7±0 .9	13.58 ± 0.52	

Bee colony population and honey production practices

In the study area, beekeepers reported varying trends in colony holdings and honey production, as per Table 7. The majority of them observed a consistent decrease in these trends over the years. This decline was attributed to several factors, leading to annual losses and an overall reduction in honey production. However, a small number of households responded by increasing their bee colony population and maintaining consistent honey production practices. Among the interviewed households, 94 (52.22%) reported periodic decreases in colony holdings and honey production, while only 16.66% stated that bee colony population and honey production had remained constant.

Table 7

Bee colony and honey production trend

Variables	Number of households (n=180)	Percent
Decreased	94	52.22
Increased	56	31.11
Constant	30	16.66

Productivity of traditional beehives and per-annum frequency of harvesting

Households in the study area still widely use the traditional method of beekeeping. Most beekeepers own traditional beehives and use traditional honey production methods. The amount of honey produced depends on the availability of bee flora and the colony's strength. According to a survey, 49 beekeepers (27.22%) gather 1-2 kg of honey per hive annually, while 74 beekeepers (41.11%) harvest 3 to 4 kg of honey per hive annually. Additionally, 52 beekeepers (28.88%) harvest 5 to 6 kg of honey per hive twice or three times annually. However, only 5 out of the total beekeepers interviewed (2.78%) did not own a traditional beehive. This suggests that the majority of beekeepers harvest a lower yield of honey per hive annually compared to the national average.

Productivity, transitional beehives, and the frequency of harvesting per year

It is important to note that not all beekeepers across all agroecologies lack transitional bee hives, but the majority of them do. In the study area, only a small number of beekeepers in the midland and highland regions have transitional bee hives and produce a small quantity of honey. In contrast, all beekeepers in the lowland areas of the study lack transitional beehives, and the transitional hive is not popular there. The productivity of these hives is determined by factors such as bee flora availability, colony strength, and so on. However, the honey yield from transitional hives in the study area was lower than the national average yield due to improper management. Only 0.56 percent of beekeepers in highland areas and 0.56 percent in midland harvested 3 to 4 kg and 5 to 6kg of honey per

hive annually, respectively, within one to two occasions. Various factors, including the availability of bee flora (pollen and nectar) and the colony's strength, influence the amount of honey a bee colony produces (Mushonga et al., 2019) However, the current yield of honey obtained from the transitional bee hive is lower than the national average. This lower yield is due to improper management of the hive.

Productivity of movable beehives and per-annum frequency of harvesting

As presented in Table 8, the study area showed that movable beehives are a valuable aid for beekeepers. The use of movable beehives enables beekeepers to harvest varying amounts of honey between one and two times per year. Researchers found that beekeepers with movable hives harvested more honey than those without. In fact, 18% of the surveyed beekeepers harvested 8–10 kg per hive annually, and 7.78% harvested 11–20 kg per hive. However, a staggering 82.22% of beekeepers did not use movable hives. Additionally, the midland beekeepers in the study area harvested more honey than their counterparts. This is because the beekeepers who lived in the midland were closer to technology than highland and lowland beekeepers. Therefore, it's clear that the use of movable beehives is essential for beekeepers to maximise their honey production.

Table 8

Productivity of movable beehive and per annum frequency of harvesting

Amount of honey harvested	Agroecology			Total
	Highland	Mid-land	Lowland	
00.00	42(23.33%)	41(22.77%)	65(36.11%)	148 (82.22%)
8-10kg	10(5.56%)	8(4.44%)	-	18(10%)
11-20 kg	-	10(5.56%)	4(2.22%)	14(7.78%)

Major Constraints of Beekeeping in the Study Area

Over time, beekeepers have observed a significant decline in the number of bee colonies in their areas, primarily due to various factors that pose significant challenges to these colonies. These challenges lead to the loss of colonies and a significant decrease in honey production. The primary constraints include pests and predators, pesticides and herbicides, a lack of beekeeping equipment, and absconding. These constraints have profound impacts on beekeepers within their agroecology. According to Degu and Megerssa (2020), beekeepers in the South West Shewa Wonchi district face significant beekeeping constraints that also challenge them across different levels in their agroecology. The survey results indicate that pesticides and herbicides are the primary problems affecting honey production in the study areas, as presented in Table 9. The use of chemicals for weed and disease control has created a bottleneck in the beekeeping sub-

sector, resulting in chemical poisoning that leads to absconding, low honey production, and colony loss across all areas. Table 9, reveals that the second major constraint hindering beekeeping practices is the lack of beekeeping equipment. The shortage of suitable technologies for production, collection, processing, and storage in the area prevented beekeepers from actively participating in beekeeping practices, resulting in the most significant obstacle to effective colony management and good honey production. Pests and predators, such as ants, hamgots, badgers, spiders, bee-eater birds, and lizards, are significant constraints on beekeeping practices. These predators damage beehives, disrupt bee colonies, eat bees, and cause colony loss through absconding. Despite efforts by beekeepers to control pests and predators using various methods, the main obstacle to beekeeping is a lack of training services. The lack of training and extension services causes beekeepers to face various constraints that reduce honey production. The lack of training discourages beekeepers from actively participating in modern beekeeping practices, preventing them from improving their livelihoods by increasing the quantity and quality of honey production. Finally, beekeepers report that absconding is a common problem, which has a significant impact on the loss of bee colonies and decreased honey production in the study area. Absconding can occur at any time of the year, and factors such as pests, predators, and discomfort in hives can contribute to this issue. Therefore, it is crucial to address these challenges to improve beekeeping practices and increase honey production.

Table 9

Indexed ranking of bee and honey production constraints

Production Constraints	Ranking in (%)					*pi*	Indexed Rank
	1	2	3	4	5		
Pesticides and herbicides used for plant protection	38	21	15	15	11	0.228	1
Lack of beekeeping equipment	21	25	33	15	6	0.215	2
Pest and predators	20	30	20	10	20	0.202	3
Lack of training and extension service	16	19	25	37	3	0.195	4
Absconding	10	18	20	16	36	0.158	5

Major opportunities for beekeeping

Toke-Kutaye district is a land of opportunity when it comes to honey production. Despite some limitations, the area boasts several prospects that are sure to boost production levels. Local beekeepers say that the presence of indigenous knowledge, abundant water resources, a wide variety of honey bee flora (Table 10), and a thriving market are just some of the advantages that make this district an ideal location for honey production.

Table 10

Bee flora, habitat and feed sources of honeybees

Scientific Name	Local name (A/ Oromo)	Type of flora	Rewards(pollen/nectar)
Vernonia Spp	*Ebicha*	Shrubs	Nectar and pollen
Eucalyptus Spp	*Bargamoo*	Tree	Nectar and pollen
Cordia Africana	*Waddeessa*	Tree	Nectar and pollen
Hayenia Abyssinica	*Heexoo*	Tree	Nectar and pollen
Acacia Spp	*Laftoo*	Tree	Nectar and pollen
Prunus Africana	*Hoomii*	Tree	Nectar and pollen
Ekebergia Capensis	*Somboo*	Tree	Nectar and pollen
Croton Macrostachyus	*Bakkannisa*	Tree	Nectar and pollen
Vernonia Auriculifera	*Reejjii*	Shrubs	Nectar and pollen
Phytolacca	*Andoodee*	Climber	pollen
Rubus Steudneri	*Goraa*	Climber	nectar and Pollen
Dovalis abyssinica	*Koshammii*	Shrubs	pollen
Pittosporum	*Soolee*	Tree	Nectar and Pollen
Carisa edulis	*Agamsa*	climber	Pollen
Sesbania	*Sasbaniyaa*	Shrubs	Pollen
Guizota Abysinica	*Nuugii*	Herbs	Pollen and nectar
Biden Spp	*Hadaa*	Herbs	Pollen and nectar
Zea mays	*Boqolloo*	Herbs	Pollen
Vicia faba	*Baqelaa*	Herbs	Pollen and Nectar
Guizotia scabra	*Tufoo*	Herbs	Nectar and pollen

Beekeeping in the study area has significant opportunities due to the availability of honeybee flora. According to the findings presented in Table 11, indigenous knowledge is one of the most important aspects for beekeepers. It is considered crucial for successful beekeeping operations, and many beekeepers have ranked it as their top priority. With indigenous knowledge, beekeepers are better equipped to manage bee colonies effectively, build traditional beehives using locally available materials, fumigate hives to attract bee colonies, and protect the colonies from pests and predators.

Typically, fathers pass down this knowledge from generation to generation, including techniques like capturing swarming honey bee colonies, identifying the strength of bee colonies, and other crucial aspects of beekeeping. Water availability is the second-most important factor for beekeepers in the study area. This is because water is essential for bee survival and honey production. Honey bees primarily use the area's numerous perennial rivers and streams during the dry season. Farmers also use these water sources for irrigation, facilitating the growth of fruits and vegetables. These crops' flowers are a source of food for bees and help them produce honey even during

the dry season. However, irrigation is only available in certain parts of the highland and midland areas. Having access to water is extremely important for beekeepers, as it provides opportunities for their colonies to thrive. Although water is available in all areas throughout the year, its availability varies in different locations, creating opportunities for beekeeping activities, as shown in the findings presented in Table 11.

Table 11

Indexed ranking of beekeeping opportunities in the study area

Opportunities	Priority level of number respondents				Index	Rank
	1	2	3	4		
Presence of indigenous knowledge	65	45	39	31	0.274	1st
Water availability	50	59	43	28	0.267	2nd
Presence of bee forage	33	44	58	45	0.231	3rd

Bee Production System and Types of Beehives.

Beekeeping is a traditional agricultural activity that aims to increase profits and acquire honey for consumption. It has been a practice involving individuals of various ages and genders. Beekeepers in the research area have utilised different techniques to maintain and expand their bee colonies. The majority of beekeepers in the research area have adopted the conventional method of hanging beehives from tree branches, as they believe this is where the colonies come and go. This contradicts the findings of Birlew (2019) and Chala (2010), who suggested that capturing natural swarms is a common practice among Ethiopian beekeepers in Dangila Woreda, while beekeepers in the Burie district of the Amhara region and the Gomma district of the Oromia region typically start beekeeping by catching swarms.We found that the traditional system of beekeeping was the most prevalent in the research area, followed by other types of beekeeping.

The traditional system of beekeeping was the most prevalent in the research area, followed by other types of beekeeping. While beekeepers in this area typically placed traditional beehives in various locations, such as their homes' eaves, backyards, and nearby trees, they also incorporated transitional and modern beehives and colonies in their backyards across all agroecologies. Conversely, 39 (21.66%) respondents opted to position their beehives and colonies in their yard, 130 (72.2%) participants chose to place them under their house eaves, and only approximately 11 (6.11%) participants decided to situate them on trees near their homestead. This observation highlights the fact that a majority of beekeepers preferred to maintain their colonies under the eaves of their houses. Contrary to the findings of Addisu and Desalegn (2021), our current research reveals that only a small percentage of colonies, 80.38% of the total colony and 73.88% of traditional colonies, were located in

backyards. This suggests that backyard beekeeping was not as prevalent as previously thought in certain districts of South Wollo Zone, Amhara, Ethiopia. Additionally, our study challenges the conclusions made by Abebe (2008) regarding beekeepers in the Tehulederie District of South Wollo Zone, Amhara Region. We discovered that most beekeepers did not place transitional and modern beehives near their houses to protect them from rain and sunlight. Instead, a few respondents placed these hives in their backyards and constructed shelters to shield them from the elements.

Each beekeeper interviewed in the research area had a unique background in beekeeping, as revealed by the findings. This aligns with the Abera (2017) study, which states that the average number of years of beekeeping experience in the Jimma Zone, Southwest Ethiopia, was 13.59 ± 9.74. To some extent, the more seasoned beekeepers demonstrated the ability to predict production outcomes by considering the past performance of less experienced families or beekeepers. In practical terms, this implies that families with more beekeeping experience can assess past honey production rates to predict future possibilities for beehive availability and honey production.

By comparing the present and past circumstances, they can also approximate the annual count of bee colonies and the amount of honey harvested in the examined area. Beekeepers attributed the decline in bee colonies and the decrease in honey production to inadequate management practices, limited adoption of technology, and the use of various chemicals by farmers in the study region to control weeds, pests, diseases, unfavourable conditions leading to absconding, as well as predators such as bee-eating birds, honey badgers, ants, spiders, and wax moths. The annual decrease in the number of honeybee colonies in traditional, modern, and transitional hives. Consequently, the findings of the current study contradict those of Biressaw et al. (2015), who reported a decrease (46.5%) and an increase (45.4%) in bee colonies in the Haramaya District, Eastern Ethiopia. The survey's results revealed that each hive type had a distinct honey yield, and the amount of honey collected varied among households and hives. Each colony within a hive determined the productivity of beekeeping. Various factors, including ecological conditions, floral availability, technology, hive type, and management practices, contributed to the different yields of honeybee colonies in the same area.

These factors also had a significant impact on beekeepers' honey output and profitability in the study area. Beekeepers or families that maintained a clean apiary site, provided additional feed, and cultivated bee-friendly flora demonstrated better care for their colonies than other beekeepers. The quantity of honey obtained from honeybees and the frequency of harvesting each year in this region primarily depended on the strength of the colonies, hive types, the availability of honeybee-friendly flora, and bee management techniques. The quantity of honey obtained from honeybees and the frequency of harvesting each year in this area primarily depended on the strength of the colonies, hive types, the availability of honeybee flora, and bee management techn iques. This suggests that the season, colony strength, and availability of bee flora or feed

all played a role in determining the frequency of honey collection each year.

Beekeeping Constraints in the Toke-Kutaye District

Over time, beekeepers have observed a considerable decline in the number of bee colonies within their respective areas. This decrease is believed to be caused by a variety of factors that pose significant challenges for bee colonies. These challenges result in colony losses and a notable decrease in honey production. The primary obstacles consist of pests and predators, the use of herbicides and insecticides, a shortage of beekeeping equipment, a lack of training and extension services, and absconding. These limitations have a significant impact on beekeepers' specific agroecology. According to Degu and Megerssa (2020), beekeepers in the South West Shewa Wonchi region face numerous beekeeping difficulties, which also have implications at different levels of their agroecology.

Beekeeping Opportunities in the Study Area

Toke Kutaye district, despite its limitations, presents several promising opportunities for enhancing honey production capacity. Beekeepers highlighted the presence of honey bee flora, water availability, and the utilisation of indigenous knowledge as key factors contributing to these opportunities. The transfer of indigenous wisdom from one generation to the next, typically from father to son, plays a crucial role in beekeeping practices. This knowledge encompasses a variety of skills, such as capturing swarming honey bee colonies, constructing traditional beehives using locally available materials, fumigating hives to attract bee colonies, assessing the strength of bee colonies, and more. These findings align with Hartmann, I. (2004), who emphasises the indigenous knowledge of beekeeping as a common practice in southwest Ethiopia.

CONCLUSIONS

Starting beekeeping, a significant agricultural activity, requires minimal land and capital. Both landowners and landless households carried out this activity, employing different beekeeping practices to yield varying quantities and levels of high-quality honey. In conclusion, the traditional beekeeping system was the most dominant, followed by other practices. Both male and female households raised bees, with male households predominantly carrying out this activity. Many beekeepers followed traditional honey production systems due to a lack of modern bee equipment, extension services, and training. Beekeepers acquired colonies using traditional methods and placed them according to their interests and experiences. The frequency of harvesting honey per hive per year was different and dependent on the availability of bee forage, colony strength, and the duration of colonies' stays in hives. We observed a number of obstacles and prospects, including the application of herbicides and pesticides, the presence of pests and predators, the absence of equipment for beekeeping, the provision of extension services, the accessibility of honey plants or bee forage, the availability of water, the accessibility of improved markets, and the reliance on indigenous knowledge.

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DECLARATION

The authors declare that they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

All data are available from the corresponding author upon request.

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