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STATUS OF HONEY PRODUCTION IN HIDABU ABOTE DISTRICT OF NORTH SHOA ZONE, OROMIA REGIONAL STATE, ETHIOPIA

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Status of honey production in Hidabu Abote District, North Shoa Zone, Oromia Regional State, Ethiopia

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THESIS APPROVAL SHEET

I certify that Kiso Gari's MSc thesis research entitled "Status of honey production in Hidabu Abote District, North Shoa Zone, Oromia Regional State, Ethiopia" has been conducted under my direct supervision. Therefore, I kindly request the Department of Zoological Sciences, Addis Ababa University for the final approval and acceptance of this thesis.

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3. Chairperson	_____	_____

DECLARATION

I declare that this thesis is my original work and that all sources of data and material used for this thesis has been duly acknowledged. I solely declare that this thesis is not submitted to any other situation to anywhere for award of any academic degree or diploma certificates.

Name：Kiso Gari Wakjira

Date_____

Signature _____

DEDICATION

This thesis research is dedicated to my friends Dagne Ababu and Siyum Bogale, who motivated and encouraged me to peruse my second degree.

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LIST OF ABBREVIATIONS/Accronyms

Am	*Apis mellifera*
CAS	Central Statistical Agency
GDP	Gross Domestic Product
Ha	Hectare
ILRI	International Livestock Research Institute
Kg	Kilogram
MASL	Meter above Sea Level
MoA	Ministry of Agriculture
NGO	Non-government Organization
SNNPR	South Nation Nationalities People Regional
SNP	Single nucleotide polymorphism
SPSS	Statistical Package for Social Science
UNEPE	United Nations Environment Program

ABSTRACT

Beekeeping is a management of honeybee colonies for the production of honey, beeswax, royal jelly, bee venom and other products. Honey is the sweets substance produced by honeybees from the nectar of blossoms or secretions on living plants; which the bees collect, transform and store in honey combs. The study was conducted in Hidabu Abote District, which is located in North Shoa Zone of Oromia Regional State to study on status of honey production. The main objective of this study was to assess the factors that affect honey production in the study area and to give recommendations for mitigating the challenges in honey production practices in the study area. To address these objective questionnaires and interview were used to collect primary data. We employed a descriptive study design technique and data were gathered from 191 people via questionnaires and interviews using random and a purposive sampling procedure. The data were organized and analyzed using statistical software for the social sciences (SPSS, version 20). The result of the study showed that 60% of beekeepers used purely traditional beehives, 1.9% used transitional beehives, 3.1% used modern beehives, 10% used traditional and transitional beehives, 20% used traditional and modern beehives, and 5% used all three types of beehives. The result also showed that honey production activity is mainly undertaken by younger people. Furthermore, about 51.9% of the beekeepers had not formal education, and about 16.3% took informal adult education. In 2017 E.C., the average honey yield from one traditional beehive was less than 10kg, from one transitional beehive 16-25kg, and from one modern beehive 20-30kg. Majority of the beekeepers (60%) managed their colonies by visiting and inspection monthly, with 15% doing so per two weeks. The major pests or predators that affecting honey production in the study area were 29.4% ants, 18.1% spiders, 16.3% birds, 15.6% wax moth, 12.5% lizard, and 8.1% Honey badger, respectively ranked 1st to 6th. Furthermore, the widespread use of agrochemicals (94.4%), lack of training (93.1%), and lack of professional support (95%) in beekeeping and the beekeeping activities of the district were dominated by the traditional system, resulted in low honey production, all had an impact on honey production practices in the study area.

***Keywords**: Beekeeping, Honeybee, Honey Production, Factors*

1. INTRODUCTION

1.1. BACK GROUND OF THE STUDY

Beekeeping is a management of honeybee colonies for the production of honey, beeswax, pollination of crops and other products. It is an environmentally friendly and non-farm business activity undertaken by farmers and landless people. That means it does not occupy cultivated land, requires less investment and provide quick economic benefits, besides it being a non-polluting intensive agricultural practice (Beyene Tadesse et al., 2007). Beekeeping activity has important contribution economically and ecologically. It has remarkable potential to contribute employment generation, local and global market, livelihood improvement, and biodiversity conservation and helps ensuring economic advantages of women, youths and Ethiopia's geographical position poor households (Beyen Tadesse et al., 2007).

The use and contribution of honeybee is diverse, including honey, beeswax, queen, bee colonies, and other product such as pollen, royal jelly, bee venom and propolis used in cosmetics and medicine. Additional role of beekeeping is pollination of food crops and many plant species used for conservation of the natural environment, and can be integrated with agricultural practice like crop production, animal husbandry and horticultural crops (Gezehagn Tadesse, 2001).

Beekeeping is a long-lasting practice in Ethiopia. As a result, beekeepers have developed indigenous technical knowledge on traditional hive construction from different local available materials, on honeybee management practices like honey season identification, swarm catching and attractant methods, swarm control methods, honeybee enemy protection, traditional methods of sting protection and reduction of pain (Workneh A, 2011).

Beekeeping has a 1.3% Gross Domestic Product (GDP) contribution to the agriculture of Ethiopia (Eskindir Amannuel and Yared Alemayehu, 2021). Ethiopia is the 1st largest honey producer country in Africa, and the 10th honey (53782 tons) and 4th beeswax (5790 tons) producer country, respectively in the world (FAO STAT, 2020). These large amounts of honey production is obtained by the presence of conductive natural resources and over 7000 flowering plant species in the country that provide the raw materials such as excess nectar and pollen for honeybees (Admassu et al., 2014).

Currently, beekeeping in Ethiopia is categorized into three system based on the type of beehives used. These are traditional (fixed-comb), transitional (top-bar), and modern (frame). Among these, about 96%, 1% and 3% of the total colony of the honeybee population are managed under traditional, transitional and modern systems, respectively. Furthermore, the total numbers of beehives found in Ethiopia are 6,958,004 (CSA, 2020). According to CSA (2021), the current honeybee colonies available in Ethiopia are about 7000.

According to CSA (2020), the major honey producing regional states in Ethiopia with total annual production are Oromia (54.3%), Amhara (19.5%), and SNNPR (Sidama. Centeral Ethiopia, South Ethiopia and South West Ethiopia but Sidama region has favorable condition for beekeeping and honey production) 16.6%.

The majority of farmers in Ethiopia use honey as a source of nutrition, brewing of locally known drinks called "Tej" and cash income (Hftey Sahle et al., 2018). Furthermore, the products of honeybee such as beeswax, royal jelly, propolis, and bee venom are used in the medicine and cosmetics industry (Gezahegn Tadesse, 2001).

According to MoA and ILRI (2013), Ethiopia has a high potential for honey production due to its natural endowment. However, the country is not producing honey with its full potential due to various factors influencing the practices of beekeeping in rural of Ethiopia. According to Adeday et al. (2012) the major constraints of honeybee production are frequent occurrence of drought, lack of bee forage, existence of pests, bee diseases, poisoning due to agrochemical and predators.

Many research studies have been done on beekeeping regarding status of honey production, marketing, constraints, and opportunities in different parts of Ethiopia including the Oromia regional state (Jimma and Illbabor (Welay Kiros, and Tekleberhan Tsegay, 2017); West Shoa (Segni Shimelis and Fufa Abunna, 2017); South West Shoa (Taye Beyene, Marco Verschuur, 2014), Amhara regional state (Gonder (Addis Getu and Malede Birhan, 2014); Hawi zone (Adino Andaregie et al., 2022), South West Ethiopia (Chala Kinati et al., 2013; Kassaye Tarekegn et al., 2017; Dreje Tulu et al., 2020; Benyam Tadesse et al., 2021; Eskindir Amanuel and Yared Alemayehu, 2021), Tigray regional state (Gebrehiwot Nahusenay, 2015), and Somali regional state (Sisay Fikiru et al., 2015).

However, studies on the status of honey production and major factors that affect honey production have been done in Hidabu Abote District. Therefore, this study was aimed to identify the status of honey production practices and the major factors affecting honey production in the Oromia regional state of North Shoa, in Hidabu Abote district kebeles.

1.2. Statement of the Problem

Hidabu Abote district is rich in natural resources that create favorable conditions to undertake status of honey production practices and make the district one of the potential districts for beekeeping sub-sector, but the district still could not exploit the existing potential to required level.

Because of different problems that limit the honey production practices in the district like pests and predators, traditional technology, poor management of bees and hives, lack of training and improper placement of hives, disease, deforestation parasite and herbicides/other insecticides chemicals. Ejigu et.al. (2009) pointed out shortage of bee forage, pesticide poisoning, lack of skilled man power and training institution, low level of technology used, honeybee pest and disease, shortage of bee colony in apiculture as the major constrains of bees and affect beekeeping in Amhara region. However, in Hidabu Abote district there is no available information about the pests and predators of honeybees, their prevalence, geographical location and other limiting factors in particular. Therefore, from this we understand that the role of the status of honey production of the community is insignificant. In this connection, the current study was designed to assess the major constraints that affect honey production in Hidabu Abote District of North Shoa Zone, Oromia Regional State, Ethiopia

1.3. Objective of the Study

1.3.1. General Objective of the Study

- ✓ To assess the factors that affect honey production in Hdabu Abote District of North Shoa Zone, Oromia Regional State, Ethiopia.

1.3.2. Specific Objective of the Study

- ✓ To investigate the honey production practices in the study area.
- ✓ To assess the honeybee management of beekeepers in Hidabu Abote District.

1.4. Basic Research Question

- What are the factors that limit honey production in the study area?
- What is the beekeeper's knowledge to manage their bee colonies?

1.5. Significance of the Study

This study mainly important for the study investigates the major factor that affect honey production in the study area and recommend solution to enhance honey production, which eventually increase the livelihood of the community and the findings of the research can also serve as valuable input for the district concerning status of honey production practices activities. In addition to this, the information collected during this study will serve as a road map for other researchers who want to carry out additional studies in this area.

2. LITERATURES REVIEW

2.1. Origin, Evolution and Distribution of Honeybee

Honeybees are one of the species that have the ability to exist in different agro-ecological zones. Honeybee probably evolved from ancient predatory wasp ancestor, contemporaneously with the flowering plants between 60 and 100 million years ago towards the end of the cretaceous period (Martin, 1976). Honey bees belong to the class: Insecta and the Order: Hymenoptera. It is believed that *Apis mellifera* originated in Asia and was distributed in Europe and Africa through natural ways. Furthermore, the molecular study using SNP on the origin of honeybee confirmed that the difference species of honeybee were introduced into different continents including South America, North America, and Australia in the early century of 16^{th}, 17^{th}, and 19^{th}, respectively through human migration (Whitfield et al., 2006).

2.2. The Species of Honeybee

According to Roubik (1989), about nine different species of honeybees have been known in the world since the late 1700s. These are *Apis mellifera, Apis florea, Apis andreniformis, Apis laboriosa, Apis vechti, Apis dorsata, Apis cerana, Apis dorsata* binghami, *and Apis cerana/indica*. Among these the following are the major honeybee species: *Apis mellifera, Apis florea, Apis dorsata and Apis cerana/inidica* and they have economic importance in honey production and crop pollination. Among the four commonly-recognized honeybee species, *Apis mellifera* is the most common dominant honeybee in the world. This honeybee species formation resulted from natural selection that enabled the honeybees to adapt to diverse geographical areas of the world for several years without the intervention of human beings. The effect of the environment on the physiological and anatomy of honeybees caused differentiation. About 20,000 bee species collect nectar, convert into honey and store as a food source. Only honeybees that live together in large colonies store appreciable quantities of honey; these include bees of the genera *Apis* (honeybee), *Trigona* and *Melipona* (stingless bees) that people have recognized throughout the ages as sources of honey (Bradbear, 2004).

In Ethiopia there are five different sub-species of honeybee that are distributed in various geographical location of the country. There was *Apis mellifera* has existed in Easter lowlands, *A. m.* litorea was found in the extreme western lowlands, *A.m.* abyssinica was available in the

central plateau and southwestern part of the tropical forest, *Apis mellifera* adansonii, was found in the southern mid-altitude area and *Apis mellifera* monticola was available in the southern moutains of Ethiopia (Ayalew Kassaye, 1990). According to the report of Smith (1961), the first honeybee that existed in Ethiopia was *Apis mellifera* monticola.

2.3. The Colony of Honeybee (*Apis mellifera*)

The colony of honeybee (*Apis mellifera*) consisting of diploid females of a queen, haploid drones, and workers with particular labor division and sophisticated to finish numerous and activities roles that are adapted to local conditions under the control of environmental factors and genetic (Seeley, 2010; Behrends and Scheiner, 2012). According to (Tarpy et al., 2015), a queen of *Apis mellifera* makes multiple mating up to 20 drones in a drone congregation area by nature that can be potentially collected from various colonies of the same species, different species, and levels of human intervention. Consequently, a colony may consist of hybrid workers of the different or closely related honeybees as a reflection of level of diversity.

2.4. Economic Importance of Beekeeping in Ethiopia

Beekeeping provides an excellent bonus to human, because only bees are capable of harvesting nectar and pollen that otherwise would inaccessible to people (Adjare, 1990; Bradbear, 2004; Melaku Girma et al., 2010).When the honeybee produces non-perishable marketable commodities, beekeeping said to be essential economic sector, which directly contributes in the value of outputs like honey, beeswax, queen and bee colonies, pollen, royal jelly, bee venom, and propolis in cosmetic and medicine (Adjare, 1990; Worknneh Abebe, 2011). The honeybee is the most essential insect in the agriculture sector of the world. According to Jacobs et al., (2006), it is the second most economically useful livestock species. It has much importance including the production of honey, royal jelly, and beeswax, the pollination of various crops and fruits, and the conservation of the ecosystem (Porto et al., 2020).

According to Haftey Sahle et al., 2018, the major contribution of beekeeping in Ethiopia includes the production of honey, beeswax, queen, and bee colonies. Additionally, products such as royal jelly, pollen, propolis, and bee venom are used in the medicine and cosmetics industry that contribute to the economy of the country by exporting abroad. Furthermore, about 85%of the

local consumption of honey are used for making a lovely local drink known as 'Tej' and only 15% of the produced honey are utilized by beekeeper at their home (Edessa Negash, 2005).

2.5. Honey production in the world and Africa

According to (FAOSTAT, 2020), Ethiopia was ranked 1st in honey production (45,300 tons) in Africa. Tanzania, Kenya, Uganda, and Rwanda were ranked from 2nd to 5th in annual honey production respectively. The top five annual honey producers countries in the world include China (444,100 tons), Turkey (109,330 tons), Canada (80,345 tons), Argentina (78,927 tons), and Iran (75,463 tons), respectively (FAOSTAT, 2020).

2.5.1. Honey Production in Africa

According to Gallmann and Thomas (2012), *Apis mellifera* occurs naturally in a great range of habitats and climatic zone across Africa, the Middle East and Europe. Many African societies have traditional skills regarding beekeeping and get benefit from bees. However, this traditional beekeeping practice is not evenly distributed among the people. Therefore, in Africa, some farmers are getting advantage from harvesting bee product. In Africa, beekeeping in beehives is practiced predominantly in Egypt, Kenya, Ethiopia and Tanzania (Hussein, 2000).

2.5.2. Honey Production in Ethiopia

Honey production in Ethiopia has a potential to strength the Ethiopian economy, reduce poverty, and conserve forests. Ethiopia has diverse habitat and flora for honeybees (Mohammed et al., 2006). The honey produced in Ethiopia is expected to become a major commodity for acquiring foreign currency to improve the Ethiopian economy. Ethiopia has longer tradition on beekeeping than any other country in the world. Beekeeping is a long-standing practice in the rural communities of Ethiopia and appears as an ancient history of the country (Ayalew, 2004).

Ethiopia has a huge natural resource base for honey production and other hive products. Since the 4th century, during the time of king Ezana, Christiantiy with strong emphasis on nomadic culture had greater contribution for intensive growth of apiculture, because of wax and honey needed for religious ceremonies and for making traditional beverages (Fitchl and Admassu, 1994).

In Ethiopia, there are two honey collecting season: the major one is that carried out from October to November and the second one from April to June. However, in addition to these major harvesting periods, there are many small harvesting periods, which depend on the type of flowering plants and rainfall patterns in different agro-ecologies, which experienced beekeepers and local people easily associated the harvesting season with the botanical origin of honey in their locality. There are a number of constraints that limit honey production practice in Ethiopia such as climate change, deforestation, and invasive species that reduce their quality of health and longevity (UNEP, 2010), According to Pokhrel (2008), predators, parasites and diseases are some of the other constraints that affect apiculture.

Parasites and diseases also affect beekeeping and this will eventually lower production due to the fact that honeybees will be destroyed by a lot of diseases, limiting the status of bees, making honey. This is attributed to lack of adequate knowledge of management practices needed in honey production. Honeybees can also be affected when using plants for their nectar that had been treated with a high concentration of pesticides. Beekeepers therefore should control damage on vegetation planted close to the project area, by making use of less concentrated pesticides on such plants or crops (Pokhrel, 2008). Honey production in mainly practiced in the rural areas. These areas have people who are less educated in agriculture due to the fact that they are unable to get funds for their education this limiting the harvesting honey yields (Yahaya and Usman, 2008).

According to CSA (2021), the numbers of traditional, intermediate, and modern beehives found in Ethiopia in the year 2020/2021 were 6,699,219, 102957, and 183,924 respectively with a total of 6986100. The honey production harvested in kilograms was 124,791328, 920,058, and 3,589,692 from traditional, intermediate, and modern beehives respectively with the total production of 129,301,078. The largest honey production was harvested from traditional beehives whereas the smallest were from intermediate at the national level.

The major total numbers of beehives and its total annual honey production in kilograms, respectively at the region state of Ethiopia in the year 2020/2021 were Oromia (3,770,056,63.3 million), SNNP (1,003,737,37.6 million), and Tigray (343,243,7.4 million). The smallest total annual honey production was observed in Dire Dawa (11749 kilograms) from only traditional beehives 3,167 (CSA, 2021).

2.6. Honeybee Management Practices in Ethiopia

The management practices of the honeybee in Ethiopia vary from beekeepers to beekeepers and from region to region. The beekeepers in our country have low honeybee management practices. For example, the majority of beekeepers (46.7%) in the Amhara region (Tessega Belie, 2009), about 53.8% in Southern Ethiopia (Haftu Kebede and Gezu Tadesse, 2014), and about 94% in the central zone of Tigray (Haftu et al., 2015) checked their honeybee in the beehives rarely, sometimes and daily, respectively for bee enemies and diseases. Moreover, about 79.3% of beekeepers in the Hadiya zone checked their bee colonies only during honey harvesting time (Eskindir Amanuel and Yared Alemayehu, 2021). According to Haftu Kebede and Gezu Tadesse (2014), most of the beekeeper of Hadiya zone (60.2%) had been visiting their honeybees during the rainy season because the different pests and predators could use the beehives as a hiding place and affect the honeybee.

2.7. Factors Affecting Beekeeping in Ethiopia

Several studies have been done in different parts of Ethiopia to identify the factors that affect beekeeping and honey production in our country. The factors discussed as follow.

2.7.1. Lack of Training and Skilled Manpower

Training and skilled manpower are essential to improve the various products of beekeeping for beekeepers. However, the lack of training and skilled man power affected the honeybee and its honey production. Lack of awareness enforced the beekeepers to use the traditional ways of honeybee and honey production which resulted in low honey production (Haftey Sahle et al., 2018). According to (Benyam Tadesse et al., 2021), the beekeeping practices in Southern Ethiopia were affected by poor extension service provided to the beekeepers.

2.7.2. Lack of Modern Technology

Beekeeping in Ethiopia has been dominated by the traditional method. As a result, the production of honey was low due to the lack of modern technology that affected the honeybee and its honey production (Benyam Tadesse et al., 2021; Dereje Tulu et al., 2020). Furthermore, the price of improved beekeeping technology was expensive and had no access to the beekeepers compared

to the traditional one. As a result, beekeepers cannot afford to buy and use it (Eskindir Amanuel and Yared Alemayehu, 2021).

2.7.3. Application of Agrochemicals

A different study conducted on the constraints of beekeeping and honey production in various parts of Ethiopia confirmed that the improper application of agrochemicals such as pesticides and herbicides on the cereal crops affecting the beekeeping practices by killing the honeybee and destroying broad-leaved crop plants used honeybee feed in Oromia in South West Shoa zone (Taye Beyene and Marco verschuur, 2014), in eastern zone of Tigray (Yetmwork et al., 2015; Hftey Sahle et al., 2018; Yibeltal Ayinalem, 2020), and in southern Ethiopia in Hadia zone (eskindir Amanuel and Yared Alemayehu, 2021).

2.7.4. Pest, Predator, and diseases of Honeybee

Honeybee and their products are exposed to various pest and predators. These pests and predators include ants, beetles, reptiles, mites, wax moths, bee-louse, Varroa, wasps, spiders, and birds that affected beehives and killed honeybees and influenced the production of honey in different part of Ethiopia (Firisa Woyessa and Dejene Alemu, 2016 (Oromia Horro Guduru Wollega); Haftey Sahle et al.,2018; Kenesa Teferi, 2018; Yibeltal Aynalem, 2020). Honeybee diseases are including amoeba diseases, chalk brood diseases, varroosis disease, and nosema diseases were the major disease causing a significance economic loss in honeybees and their product (Desalegn B, 2001; Sisay Fikiru et al., 2015; Segni Shimelis, 2017; Eskindir Amanuel and Yared Almayehu, 2021).

However, the Status of honey production has not been studied in Hidabu Abote District of North Shoa, Oromia Regional state, Ethiopia.

3. Materials and Methods

3.1. Description of the Study Area

The study was conducted in Hidabu Abote District of North Shoa Zone, Oromia Regional State, Ethiopia. In geographical term the district is located between 9°48'30"−10°4'40"N latitude and 37°24'00"−38°40′12"E longitude at about 147km from the national capital, Addis Ababa to North direction and 42km from zonal capital, Fithche. Based on agro-ecology Hidabu Abote District is classified into highland 12.9%, midland 73.4% and lowland 13.7% with altitude range of 1110-2963m.a.s.l. The district has a total of 20 kebeles with 19 rural and 1 urban. There are about 3302 beekeepers in Hidabu Abote District with 8332, 4260 and 2567 traditional, transitional and modern hives, respectively. The total annual honey production of the District was 216,219kg (Hidabu Abote District Agricultural Office Report, 2024).

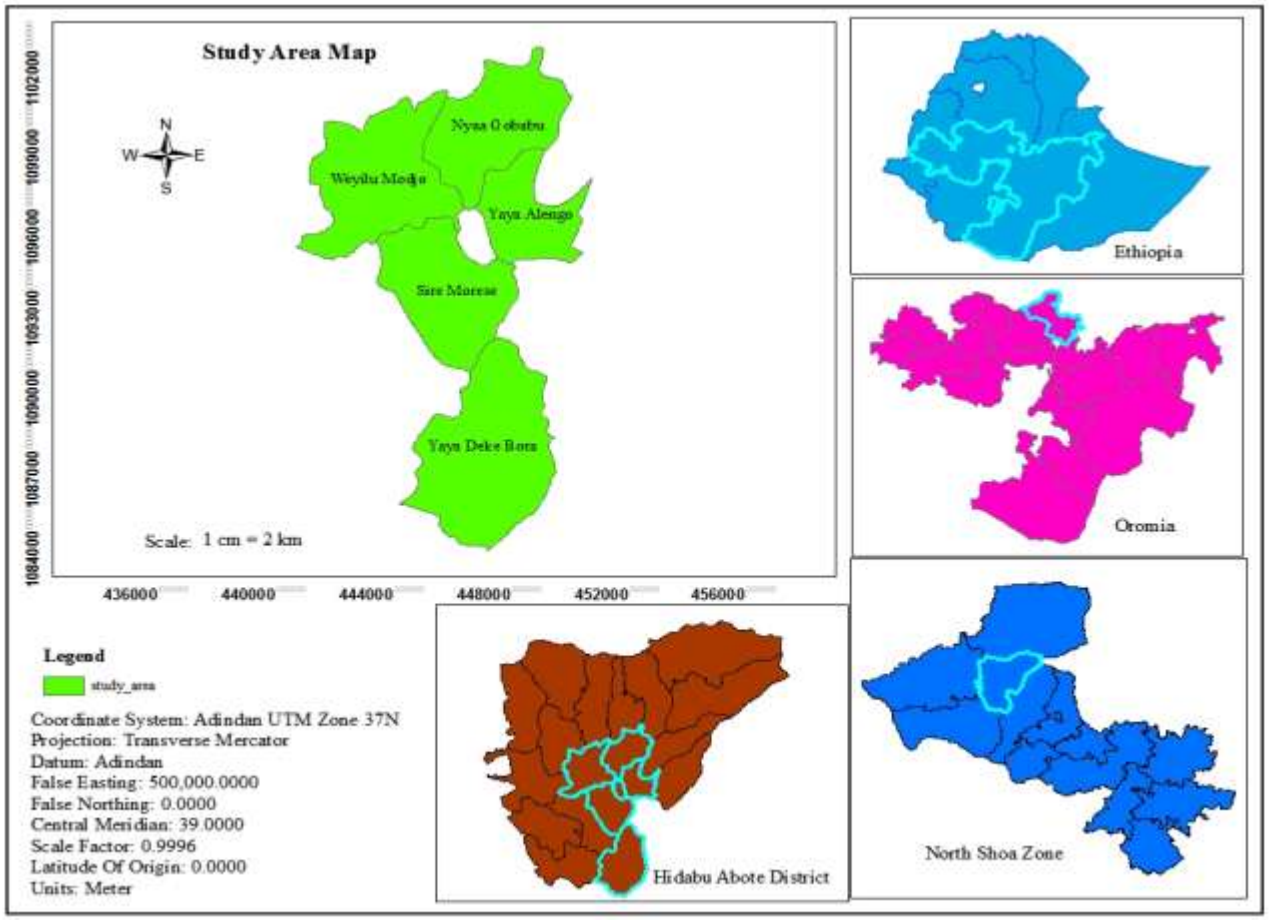


Figure 1. Map of the study area

Source: Ethio-GIS, 2013

3.2. Study Design, Sampling Techniques and Sample Size

For this study, a descriptive research design was used. Both random and purposive sampling technique was used to select data. On the basis of the potential of honeybee colonies and security issue, Hidabu Abote District and its five representative kebeles were specifically chosen. The study kebeles were Wellu Mojo, Gnea Gababu, Sire Morose, Yaya Dakabora and Yaya Alango for data collection. The beekeepers were chosen randomly in order to collect data using questionnaire. However, a purposive sampling strategy was used for interview.

The sample size was calculated using Yamane's sample size determination formula at a 95% confidence level with 7% of precision level (Yamane, 1967). The total numbers of beekeepers in Hidabu Abote District were 3302. As a result, 191indviduals participated in this study.

$$n = \frac{N}{1+N(e)^2} = \frac{3302}{1+3302(0.07)^2} = 191$$

Where:

n = number of participant

N =total number of household beekeepers

e =level of precision

1= designates the probability of the event occurring

3.3. Data Collection Method

Data were gathered from primary sources. The primary data were collected randomly from the beekeepers using a semi-structured questionnaire and semi-structured interviews from key informants with the researcher from each kebele. Data were collected from 160 beekeepers using questionnaires (32 beekeepers participated from each kebele). Furthermore, 25 key informant model beekeeping farmers and six livestock expert participants were participated in the interviews. Additionally, visual observation was also used to support the interpretation of the collected data. The questionnaire were prepared in English and translated into local language (Afan Oromo) during data collection.

3.4. Data Analysis Method

The collected data was analyzed using appropriate statistical packages for Social Science (SPSS-software Version 20). Furthermore, descriptive statistics, such as mean, frequency, and standard deviation was also used.

4. RESULTS

4.1. Socio-economic background of the beekeepers

Information about the socio-economic background of the beekeepers is shown in Table 1, including sex, age, educational level, household headed numbers of beehives, and the size of plot of farm land in hectare. In Hidabu Abote there were 91.25% male beekeepers and 8.75% female beekeepers who participated in the honey production process. Ages of beekeepers ranged from 41-50 and 20-30 years, respectively, with maximum (41.3%) and minimum (6.9%) participation in honey production. The education level ranged from who had no formal education to degree level. About 51.9% of the people had no formal education. About 43.8% of the beekeepers had less than five beehives, whereas 9.4% had more than 20 beehives and 40.6% of beekeepers had 1-2 hectare.

Table 1. Socio- economic background of the beekeepers in Hidabu Abote District

Variables, respondent status and percentage													
Sex			Age			Educational status			Beehives			Plot of farm land		
	Number	Percentage	Level	Number	Percent	Level	Number	percent	Beekeepers owned beehives	Number	percent	In hectare	number	Percent
Male	146	91.25	20-30	11	6.9	uneducated	83	51.9	<5	70	43.8	<1	40	25
Female	14	8.75	31-40	18	11.3	Basic education	26	16.3	5-10	43	26.9	1-2	65	40.6
			41-50	66	41.3	Grade 1-4	21	13.1	11-15	12	7.5	2.1-3	35	21.9
			51-60	43	26.9	Grade 5-8	10	6.3	16-20	20	12.5	3.1-4	10	6.3
			≥ 60	22	13.8	Grade 9-12	9	5.6	>20	15	9.4	4.1-5	7	4.4
						Diploma	5	3.1				>5	3	1.9
						Degree	6	3.8						

4.2. Types of beehives used and its source in Hidabu Abote District

In Hidabu Abote District, beekeepers produced honey using traditional, transitional and modern beehives (Table 2). Only traditional, transitional, and modern beehives were used by 60%, 1.9% and modern 3.1% of beekeepers, respectively. Beekeepers also employed a mixed type of beehives, including traditional and transitional (10%), traditional and modern (20%), and all three types (5%). About 27.5% of beekeepers prepared their own beehives compared to 57.5% who purchased it from market. An NGO called Sustainable Land Management Program (SLMP) gave modern beehives to 15% of the beekeepers. Surprisingly, the government did not provide the beekeepers with any modern beehives.

Table 2. Types of beehives used and its source in Hidabu Abote District

Types of beehives	Number of respondent	Percent (%)
Only traditional	96	60%
Only transitional	3	1.9%
Only modern	5	3.1%
Traditional and transitional	16	10%
Traditional and modern	0	0%
Transitional and modern	32	20%
All three types	8	5%
Source of beehives		
Prepared by beekeepers	44	27.5%
Grant given from government	0	0%
Grant given by NGO	24	15%
Bought from market	92	57.5%

4.3. The prices of beehives in Ethiopian birr in Hidabu Abote District

In Hidabu Abote District, prices of beehives in Ethiopian birr shown in Table 3. The minimum prices of traditional, transitional, and modern beehives were 250 Eth birr, 500 Eth birr, and 4500 Eth. birr respectively, whereas the maximum prices traditional, transitional, and modern beehives were 500 Eth birr, 1000 Eth birr, and 5000 Eth birr respectively.

Table 3. The prices of beehives in Ethiopian birr

Types of beehives	Prices of beehives		
	Minimum	Maximum	Average
Traditional	250	500	362.7
Transitional	500	1000	689
Modern	4500	5000	4933.3

4.4. Placement of beehives in Hidabu Abote District

Regarding the placement of beehives the majority of the respondents (94.4%) placed their beehives at backyard in open space, while 5.6% of the respondents placed their beehives at backyard under their eaves of home (Table 4).

Table 4**. The placement of hives in Hidabu Abote District**

Placement of hives	Numbers of respondents	percentage
Backyard in open space	151	94.4%
Backyard under their eaves of home	9	5.6%

The different types of beehives and their placement in the study areas of the district demonstrated in Figure 2, 3, 4, & 5. Accordingly, traditional beehives at backyard in open space, and under the eaves of home, transitional and traditional beehives at backyard in open space, all three types of beehives at backyard in open space, and modern hives at backyard in open space were some of the practices observed in the district.



Figure 2. Traditional beehives at backyard in open space and under the eaves of home



Figure 3. Traditional and transitional beehives at backyard in open space



Figure 4. All three types of beehives at backyard in open space



Figure 5. Modern beehives at backyard in open space

4.5. Management of honeybee colonies, and swarming in Hidabu Abote District

Most of beekeepers (60%) managed their bee colonies by visiting and inspecting their colonies monthly, 7.5% daily, 9.4% weekly, 15% per two weeks, and 8.1% during honey harvesting time. During the honeybee colonies visit, 25% of the beekeepers checked the presence or absence of colonies, 34.4% observed insect problem externally, while 12.5% checked the status of honey production, and 28.1% checked the condition of beehives. About 88.75% beekeepers managed swarming by transferring to empty beehives, 5% harvesting honey combs, and 10% removal of queen cells, as shown in Table 5.

Table 5. Honey bee colonies visits and management methods of swarming

S/N	Variables	Number of respondent	percentage
1	**Time of visit and inspection of honeybee colonies**		
	Daily	12	7.5%
	Weekly	15	9.4%
	Per two week	24	15%
	Monthly	96	60%
	During honey harvesting time	13	8.1%
2	**Honey bee colonies visit**		
	Presence or absence bee colonies	40	25%
	Insect problem	55	34.4%
	Status of honey production	20	12.5%
	Condition of beehives	45	28.1%
3	**Managements method of swarming**		
	Transferring to empty beehives	142	88.75%
	Harvesting honey combs	8	5%
	Removal of queen cells	10	6.25%

4.6. The annual honey production from a single beehive, and the price of honey per kilogram in Hidabu Abote District

The categories of beehives, the annual honey production from one beehive and the price of honey per kilogram in Ethiopian birr in 2017 E.C. at the study area are shown in Table 6. The average annual yields of honey from traditional, transitional, and modern beehives were, <10kg, 16-25kg, and 20-30kg respectively. The price of one kilogram of honey harvested from traditional and transitional beehives minimum 700 Eth. Birr, maximum 800m Eth. Birr, and 747.6 average Eth. Birr, and the price of one kilogram of honey harvested from modern beehives minimum 900 Eth. Birr, maximum 1000 Eth. Birr, and 962.3 average Eth birr.

Table 6. Honey harvested in kilograms from one beehive per year and its selling prices in 2017 E.C

Types of beehives	Average of harvested honey per year in kilogram from one beehive	Price of one kilogram honey harvested from the three types of beehives in 2017 E.C in Eth. birr		
		Minimum	Maximum	Average
Traditional	<10kg.	700 Eth. birr	800 Eth. birr	747.6 Eth. birr
Transitional	16-25kg.	700 Eth. birr	800 Eth. birr	747.6 Eth. birr
Modern	20-30kg.	900 Eth. birr	1000 Eth. birr	962.3 Eth. birr

4.7. The frequency of honey collection annually in Hidabu Abote District

In the study area, honey was harvested by beekeepers once (92.5%), and twice (7.5%) per year respectively, as shown in Table 7. The period of honey harvesting was also found to be associated with the flowering seasons of various trees, bushes and grass species found in the vegetation cover of the area. In the study area the major honey harvesting season was from October to December. Exceptionally the minor honey harvesting season was in Hidabu Abote District from May to June.

Table 7. The frequency of honey collection per year in Hidabu Abote District

Frequency of honey collection per year	Number of respondents	Percentage
Once	148	92.5%
Twice	12	7.5%

4.8. Honey selling place in Hidabu Abote District

According to beekeepers said they sold their honey at a variety of locations, including the local market (90.6%), and in the village (9.4%). At farmers' cooperatives and local Tej houses, they did not sell, as shown in Table 8. From traditional and transitional beehives they sold it for a mean price of 747.6 Eth. Birr with a minimum price of 700 Eth. Birr and a maximum price of 800 Eth. Birr, and from modern beehive they sold it for a mean price of 962.3 Eth. Birr, with minimum 900 Eth. Birr a maximum price of 1000 Eth birr.

Table 8. Honey selling places in Hiadabu Abote District

Honey selling places	Number of respondent	Percentage
Village	15	9.4%
Local market	145	90.6%
Tej house	0	0.0
Farmers' cooperatives	0	0.0

4.9. The major factors that affecting honey production in Hidabu Abote District

There were different major factors that affected honey production in Hidabu Abote District.

4.9.1. Honeybee pests and predators

The major pests or predators that affected honey production in the study area were 29.4% ants, 18.1% spiders, 16.3% birds, 15.6% wax moth, 12.5% lizard, and 8.1% Honey badger, respectively ranked 1st to 6th shown in Table 9 below.

Table 9. Major pests and predators that affected honey production in Hidabu Abote District

S/N	Variable	Number of respondent	percentage	Rank
1	Birds	26	16.3%	3
2	Spiders	29	18.1%	2
3	Ants	47	29.4%	1
4	Lizard	20	12.5%	5
5	Wax moth	25	15.6%	4
6	Honey badger	13	8.1%	6

4.9.2. Agrochemicals, Capacity building, and other related constraints

About 94.4% of beekeepers used different agrochemicals to protect their crops from weeds, insect and pests, whereas 93.1%, and 95% didn't receive any training and professional support on beekeeping, respectively. Training and skilled manpower are essential to improve the various products of beekeeping for beekeepers. However, the lack of training and skilled manpower affected the honeybee and its honey production. Only 6.9% of beekeepers got training, and 5% got professional support on beekeeping. There was a 97.5% colony absconding, and 96.9% occurrence of swarming in the studied area, as shown in Table 10 below.

Table 10. Use of agrochemicals, capacity building, and other related constraints that affecting honeybee production in Hidabu Abote District

Studied variables		Number of respondent	percentage
Possession of empty beehives	Yes	140	87.5%
	No	20	12.5%
Training taken on beekeeping	Yes	11	6.9%
	No	149	93.1%
Professional support taken on beekeeping	Yes	8	5%
	No	152	95%
Use of agrochemical	Yes	151	94.4%
	No	9	5.6%

Colony absconding	Yes	156	97.5%
	No	4	2.5%
Occurrence of swarming	Yes	155	96.9%
	No	5	3.1%

4.9.3. The availability of water at all time, sources of water, and sources of forage for honeybee

As the beekeepers responded, the availability of water at all the time was 100%, and the honeybees got water from stream (28.75%), from river (46.25%), and from home (25%). Furthermore, the honeybees got their food from the forest or field (86.9%), and got food prepared at home (13.1%), as shown in Table 11.

Table 11. The availability of water at all time, source of water, and source of forage for honeybee were the constraints that affect honey production in Hidabu Abote District

No	Variables	Number of respondent	Percentage
1	Availability of water at all time	160	100%
2	Sources of water for honeybee		
	Stream	46	28.75%
	Rivers	74	46.25%
	Provided by myself/ at home	40	25%
3	Sources of forage for honeybee		
	From forest/ field	139	86.9%
	From home/ prepared at home	21	13.1%

4.10. The feeding of honeybee's and flowering period/season

Honey bee colonies naturally sustain themselves and produce honey by foraging from natural and cultivated crops in all possible radiuses from their nests and store honey for their own consumption during dearth period. In terms of preference by honeybees and abundance, the most important sources of honeybee forage shown in Table 12.

Most important honeybee floras of the study area bloom between August and September. Similar plant species were identified as major pollen and nectar sources, for honeybees in Hidabu Abote districts

Table 12. The Honeybee forages that reported in the study area from respondents.

No	Species name	Local name/afan oromo	Life form	Flowering period/season
1	*Eucalyptus spp*	Bargamoo	Tree	November–January
2	*Croton macrostachys*	Bakkanniisa	Tree	August–October
3	*Vernoniaspps*	Eebicha	Tree	October–December
4	*Ocimum basilicum*	Besobilaa	Shrub	May–July, Octo–Decemb
5	*rubusspp*	Goraa	Tree	July–November
6	*Mangifera indica*	Maangoo	Tree	May–June
7	*Cicer arietium*	Shumburaa	Shrub	November–December
8	*Allium cepa*	Shunkurtii	Crop	April ,June, Septr–Nove
9	*Negeta azurea*	Dama-kesee	Shrub	May–June
10	*Guizotia abyssinica*	Nuugii	Crop	September–November
14	*Cucuerbita pepo*	Dabaaqula/buqqee	Shrub	May–July
15	*Pisum sativum*	Atara	Crop	August–September
16	*Vicia faba*	Baaqelaa	Crop	August–September
17	*Musa paradisca*	Muuzii	Vegetable	Any time
18	*Trifoliumspp*	Siddisa	Shrub	September–October
19	*Lathyms sativa*	Guwayyaa	Shrub	November–December
20	*Guizotia scarbe*	Tufoo	Shrub	April –June
21	*Carissa edulis*	Hagamsa	Tree	June–October
22	*Bidens prestinaria*	Keelloo	Shrub	September–October
23	*Zea maize*	Boqqolloo	Crop	July–August
24	*Olea aficana*	Ejersa	Tree	Any time
25	*Cordia africana*	Waddeessa	Tree	March–April

5. Discussion

Beekeeping is an important component of agriculture and rural development program in many countries. The role of beekeeping in providing nutritional, economic and ecological security to rural communities at the household level and is an additional incoming generating activity. In beekeeping activities, the participation of males (91.25%) was much higher than that of the participation of females (8.75%) in Hidabu Abote District. This shows that in the study area honey production was dominated by male and women were not encouraged to involve in honey production business. Haftu Kebede and Gezu Tadesse (2014) reported that 93% of the participants in Southern Ethiopia were males and 7% were females, while Segni Shimelis and Fufa Abunna (2017) found that 91.1% of the participants in West Shoa were males and 8.9% were females on honey production. Fewer women participate on beekeeping due to cultural norms that viewed it as a male job (Addis Getu and Malede Birhan, 2015; Teklu Gebretsadik, 2016). Furthermore, it was a cultural taboo in communities for a female to climb a tree to hang the hives. This result agreed with Hartmann (2004) who reported that in Ethiopia traditionally honey production is males' job. Such gender biased practice kept the honey production productivity low.

The age of the beekeeper is very essential to determine the type of agricultural activities engaged by the beekeepers. The current study showed that 41.3% of the beekeepers in the study area were productive and active age groups (41-50) were participating in honey production. This result agreed with the result reported by Taye Beyene and Marco Verschuur (2014) that beekeepers had a mean age of 49 years in the South West Shoa Zone and 40.2 years in Jimma and Illubabor (Welay Kiros and Tekleberhan Tsegay, 2017).

Education is important to utilize improved honeybee production technology, for fast transfer knowledge and to increase production and productivity. Regarding educational levels of the beekeepers (51.9%) and (16.3%) who engaged in beekeeping activities had uneducated and informal adult education levels, respectively. This result showed that the low education level could highly affect the activities of beekeeping and the use of modern technology in the study areas. Relatively similar and much higher finding were reported that 18.33% and 60% of the beekeepers had informal adult education and uneducated status of education levels, respectively in the West Guji Zone (Hussen Abduku, 2023). Farthermore, Eskindir Amanuel and Yared

Alemayehu (2021) reported that 39.3% of the beekeepers who participated in the honey production were uneducated which are similar finding with our current observation. Less than five beehives were utilized by many beekeepers (43.8%) in the study areas to produce honey, showing that beekeeping was done to generate extra income. Beekeeping was used for household consumption and generating additional income in Jigjiga Zone (Sisay Fikru et al., 2015).

The result of the study showed that most of the beekeepers (60%) were used traditional beehives for honey production in the study areas. On the other hand, a few of them (3.1%) used only modern beehives. This result is similar with the finding of Benyam Tadesse et al., (2021) that 65% and 0% of the beekeepers used traditional and modern beehives for honey production in South west Ethiopia.

Furthermore, beekeepers widely used traditional beehives in the study areas, because it's easy to construct from locally available materials and it is very cheap, while modern beehives are very expensive in the study area. In contrast, the higher costs of modern beehives and a lack of knowledge limited their usage. Our findings agree with the results of (Sisay Fikru et. al., 2015; Firisa Wayessa and Dejene Alemu, 2016; Welay Kiros and Tekleberhan Tsegaye, 2017) who reported that most beekeepers were use traditional beehives than modern beehives.

The finding study demonstrated that the government didn't granting modern beehives to the beekeepers and didn't give training and professional support to the beekeepers in the study areas. This finding study was agreeing with the result of (Haftey sahle et al., 2018) who reported that training and skilled manpower are essential to improve the various products of beekeeping for beekeepers. Lack of awareness enforced the beekeepers to use the traditional ways of honeybee and honey production which resulted in low honey production.

Furthermore, the government did not assign an expert for functioning the farmers' cooperative which was built in the study area and fulfilled with modern materials by Agriculture Growth Program (AGP). On the other hand, some modern beehives granting for the beekeepers and some training given for the beekeepers by an NGO called Sustainable Land Management Program (SLMP).

In Hidabu Abote District, beekeepers employed traditional, transitional, modern, traditional and transitional, traditional and modern beehives to produce honey. The majority of beekeepers

(92.5) collected honey once a year. The average honey production collected per year from one traditional beehive was <10kg, from one transitional beehive 16-25kg, from one modern beehive 20-30kg. The highest honey production was collected from a single modern beehive per year, while traditional beehives produce the lowest yields. This finding showed that the employment of modern beehive produces a higher yield of honey, whereas the traditional of beekeeping produce poor result. Similar finding was reported by Beyene and Verschuur, (2014) in which 5kg, 10kg, and 16kg of honey was harvested from traditional, transitional, and modern hive, respectively in wonchi district West Shoa Zone.

Most of the beekeepers in the study areas externally managed the presence/ absence of colonies and swarming through daily, weekly, per two weeks and monthly inspection and transferring the colonies into the prepared empty beehives, respectively. However, the majority of the beekeeper did not inspect honey production status when they were visiting their colonies. These results confirmed that the beekeepers didn't check the colonies internally due to the placement of traditional beehives, which made it difficult for internal inspection. A similar result was reported by Hftu Kebede and Gezu Tadesse (2014) in Hadiya Zone and Alemayehu Tolera et al. (2022) in Horo Guduru that beekeepers did not practice internal inspection for their colonies management

Regarding placement of beehives the majority of the beekeepers (94.4%) placed their beehives at backyard in open space, and few of them (5.6%) placed their beehives under the eaves of their home, respectively. This result agreed with Tessega Belie (2009) who reported that most of the beekeepers placed their honeybee colonies at backyard, and inside their house.

The major pests and predators that constrained honey production in the study areas were ants, spiders, birds, wax moth, lizard, and Honey badger 1^{st} to 6^{th} in the current findings. Our findings were consistent with those of many researchers who reported from different parts of Ethiopia that the main pest and predators that constrained honey production with varying ranks at different study areas included ants, wax moth, birds, spiders, lizards, and Honey badger in the Tigray region (Teklu Gebretsadik, 2016), spider, lizards, and birds in the West Shoa Zone (Segni Shimelis and Fufa Abunna, 2017), ants and wax moth in Guji Zone (Hussen Abduku, 2023).

Furthermore, the extensive use of agrochemicals like pesticides, herbicides, and fungicides (94.4%), lack of training (93.1%), and professional support (95%) in beekeeping, colonies

absconding (100%), lack of proper management for bees and beehives, and failure to use modern beehives (96.9) were the main constraints that affecting beekeeping activities and honey production practices in the study areas. The majority of beekeepers utilized different agrochemicals to control pests and weeds out of their crops. These agrochemicals had the potential to kill the honeybee, which reduced the amount of honey produced, and destroyed broad-leaved crop plants used for honeybee as forage. Our findings were in agreement with the findings of Benyam Tadesse et al., 2021; Gratzer et al., 2021 and Hussen Abduku (2023). On the other hand, honeybees in the study areas did not get plenty of water and food during the dry seasons. The current finding was similar with those reported by (Haftey Sahle et al., 2018) and Yibeltal Ayinalem (2020), who claimed that a lack of water and bee fodder were constraints that had an impact on honey production in their study regions.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

The results of the study showed that the major constraints that affected beekeeping activities and honey production in Hidabu Abote District include: lack of use of modern beehives due to its high cost and lack of awareness, lack of training, and professional support on beekeeping, lack of internal inspection of colonies, improper placement of beehives, presence of colonies absconding, lack of material and technical support from concerned bodies, extensive use of agrochemicals such as pesticides and herbicides. The finding of the study also revealed that the major constraints that hindered beekeeping activities and honey production: pests and predators such as ants, spiders, birds, wax moth, lizards, and Honey badger. These pests and predators were constraints honey production activities by consuming the honey, killing the bee colonies, and destroyed the combs. These constraints resulted in decreasing in bee colonies, which in turn reduce honey production, finally affecting the income of the beekeepers to support their livelihood.

Furthermore, the beekeeping activities of the district were dominated by the traditional system, which resulted in low honey production. The local government paid less attention to the honey production activities of the district. These less attention enforced the beekeepers as they used the traditional ways of beekeeping system which resulted in low honey production. The beekeeping farmers' cooperatives which was established in the study areas and fulfilled with modern materials did not function because of the lack of skilled manpower that given awareness for the beekeepers as they did not sell their honey at cheap prices in villages and local markets.

6.2. Recommendations

- The local government and non-government (NGO) should support beekeepers by granting modern beehives for the beekeepers to replace the traditional beekeeping system with the modern beekeeping system and the beekeepers should combine external and internal colony checks in order to overcome the constraints of honey production.
- Increasing production and quality of honey by improving management practices, placement of beehives and environmental conservation.

- To improve the factors that affect honey production, the district agricultural office should give attention to beekeeping activities, organize beekeepers at the cooperative level, and employ experts to function in modern technology prepared for beekeepers' cooperatives at the district level.
- Emphasis should be given to continuous training and support for beekeepers on how to use modern honey production technology to enhance quantity and quality of honey.
- To improve the constraints that affecting honey production activities, the district Agricultural office should create market networking for beekeepers to sell their honey products at reasonable prices.
- To improve the factors that affecting honey production, intervention measures should be taken to improve the traditional beekeeping system through training, encouraging to use modern technologies, and granting and providing modern beehives by adequate prices.

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APPENDICES

1. APPENDICES 1. Questionnaire prepared for data collection from beekeepers in 2025.

ADDIS ABABA UNIVERSITY, DEPARTMENT OF BIOLOGY

This questionnaire is prepared by Kiso Gari Wakjira, MSc student in Addis Ababa University, Department of Zoological Science for partial fulfillment of master degree. The aim of this questionnaire is to collect data about assessment of honeybee for honey production practices in Hidabu Abote District North Shoa Zone of Oromia Regional State, Ethiopia. The information you provide is believed to have great value for the success of this research. Therefore, I would like to ask you to give me genuine information about your beekeeping practices. Thank you in advance.

The main objective of this study is to assess the major constraints that affecting honey production practices by smallholder beekeepers.

General Instruction: the researcher uses this questionnaire for the genuine information is highly decisive to the success of this study, therefore:-

Encircle a choice that is appropriately represents your response in the multiple choice question.

To the open-ended questions, please write your response on the space provided.

1. Background of the beekeeper:

   Name:_____

   Sex/ gender of the respondent: 1/ male 2/ female

   Age of respondent: 1/ <20 2/ 20-30 3/ 31-40 4/ 41-50 5/ 51-60 6/ ≥61

   Educational level of the respondent: 1/ uneducated 2/ Basic education 3/ Grade 1-4 4/ Grade 5-8 5/ Grade 9-12 6/ Diploma 7/ Degree

   Household headed: 1/ male 2/ female

   Number of beehives: 1/ <5 2/ 5-10 3/ 11-15 4/ 16-20 5/ ≥21

   Plot of farm land: 1/ <1ha 2/ 1-2ha 3/ 2.1-3ha 4/ 3.1-4ha 5/ 4.1-5ha 6/ ≥5ha

2. What type of beehive do you use for honey production? 1/ traditional 2/ transitional 3/ modern

3. Where do you get the beehives you use for honey production?
   1/ prepared by myself 2/ Grant given from government 3/grant given by NGO
   4/ bought from market
4. If you bought from the market, for how much Ethiopian birr did you buy?
   1/ traditional_____ 2/ transitional_____ 3/ modern_____
5. Where did you keep your bee colonies? 1/ Backyard 2/ under the eaves of home 3/ Hanging on tree near home 4/ any other specify _____
6. Did you take any training on beekeeping? 1/ yes 2/ no
7. Did you get any professional support on beekeeping from agricultural extension worker? 1/ yes 2/ no
8. How many times do you collect honey per year? 1/ once 2/ twice
9. Do you have an empty beehive? 1/ yes 2/ no
10. If your answer for question number 9 is yes, how many empty beehives do you have? _____
11. Do you use agrochemicals for crop production? 1/ yes 2/ no
12. If your answer for question number 11 is yes, what kind of agrochemical do you use? 1/ Insecticides 2/ herbicides 3/ fungicides
13. Do you think that usage of agrochemical on crop production as it affect honeybees?
    1/ yes 2/ no
14. Does water available for your honeybees at all the time? 1/ yes 2/ no
15. If your answer for question number 14 is yes, from where your honeybee colonies get water? 1/ stream 2/ river 3/ provide by myself 4/ pond
16. From where your honeybee colonies get its forage most of the time? 1/ from forest/field
    2/ I prepare and provide it to my honeybee colonies 3/ any other specify _____
17. How many frequent do you visit and inspect your honeybee colonies?
    1/ daily 2/ weekly 3/ per two weeks 4/ monthly 5/ during honey harvesting time
    6/ during rain time 7/ I do not visit my honeybee colonies
18. If you visit your honeybee colonies, what do you check most of the time? (Your answer can be more than one).
    1/ presence or absence of bee colonies 2/ honey production status 3/ condition of beehives 4/ insect problem 5/ any other specify _____
19. Have you encountered colony absconding in your beekeeping practices? 1/ yes 2/ no

20. What are the major constraints that affect the honeybee production in your area? Please identify them by ranking.

    1/ bee eater birds (rank___) 2/ spiders (rank___) 3/ ants (rank___) 4/ lizard (rank___) 5/ wax moth 6/ hamagot (rank___)

21. Does swarming (bee colonies reproduce to form new colonies) occur in your colonies?

    1/ yes 2/ no

22. How do you manage swarming? 1/ transferring into empty beehives 2/ harvesting honey combs 3/ removal of queen cells 4/ others specify

23. How many kilogram of honey do you harvest from one beehive per year on average?

    Traditional: 1/ <10kg 2/ 11-20kg 3/ 21-30kg 4/ >30kg

    Transitional: 1/ <15kg 2/ 16-25kg 3/ 26-35kg 4/ >35kg

    Modern: 1/ <20kg 2/ 20-30kg 3/ 30-40kg 4/ >40kg

24. Where do you sale your honey products? A/ in the village B/ local market 3/ Tej house 4/ at farmers cooperatives

25. On average, at what price did you sell a one kilogram of honey in this year (2017 E.C) in Ethiopian birr?

    1. Traditional _____

    2. Transitional _____

    3. Modern _____

Thank you very much for your cooperation

2. **APPENDICES 2**. Interview Questions prepared for data collection from model beekeepers in 2025

ADDIS ABABA UNIVERSITY, DEPARTMENT OF BIOLOGY

This interview question is prepared by Kiso Gari Wakjira, MSc student in Addis Ababa University, Department of Zoological Science for partial fulfillment of master degree. The aim of this interview question is to collect data about assessment of honeybee for honey production practices in Hidabu Abote District North Shoa Zone of Oromia Regional State, Ethiopia. The information you provide is believed to have great value for the success of this research. Therefore, I would like to ask you to give me genuine information about your beekeeping practices. Thank you in advance.

The main objective of this study is to assess the major constraints that affecting honey production practices by smallholder beekeepers.

General Instruction: the researcher uses this interview questions for the genuine information is highly decisive to the success of this study, therefore:-

Please try to give me the genuine information.

Background of the model beekeeper:

Name:_____

Sex/ gender of the respondent: 1/ male 2/ female

Age of respondent: 1/ <20 2/ 20-30 3/ 31-40 4/ 41-50 5/ 51-60 6/ ≥60

Educational level of the respondent: 1/ uneducated 2/ Basic education 3/ Grade 1-4 4/ Grade 5-8 5/ Grade 9-12 6/ Diploma 7/ Degree

Household headed: 1/ male 2/ female

Number of beehives: 1/ <5 2/ 5-10 3/ 11-15 4/ 16-20 5/ ≥21

Plot of farm land: 1/ <1ha 2/ 1-2ha 3/ 2-3ha 4/ 3.1-4ha 5/ 4.1-5ha 5/ ≥5ha

1. What are the major factors that constringing your honey production? _____
2. What is the status of your honey production in 2017 E.C? _____
3. Does the government facilitate the market for selling your honey in the district? _____

4. Which types of beehives do use mostly?
    A. Traditional
    B. Transitional
    C. Modern
5. What kinds of support do you want from government that you did not get it before to improve your honey production more? _____

Thank you very much for your cooperation

3. APPENDICES **3**. Interview Questions prepared for data collection from Hidabu Abote livestock expert and Agricultural supervision in 2025

ADDIS ABABA UNIVERSITY, DEPARTMENT OF BIOLOGY

This interview questions is prepared by Kiso Gari Wakjira, MSc student in Addis Ababa University, Department of Zoological Science for partial fulfillment of master degree. The aim of this interview question is to collect data about the assessment of honeybee for honey production practices in Hidabu Abote District North Shoa Zone of Oromia Regional State, Ethiopia. The information you provide is believed to have great value for the success of this research. Therefore, I would like to ask you to give me the genuine information about your beekeeping practices.

The main objective of this study is to assess the major constraints that affecting honey production practices by smallholder beekeepers.

General Instruction: the researcher uses this interview questions for the genuine information is highly decisive to the success of this study, therefore:-

Please try to give me the genuine information.

Background of the livestock expert and agricultural supervisors:

Name:_____

Sex/ gender of the respondent: 1/ male 2/ female

Age of respondent: 1/ <20 2/ 20-30 3/ 31-40 4/ 41-50 5/ 51-60 6/ ≥60

Educational level of the respondent: 1/ Illiterate 2/ Basic education 3/ Grade 1-4 4/ Grade 5-8 5/ Grade 9-12 6/ Diploma 7/ Degree

1. What are the major factors that affecting honey production in the kebele you are supporting?
2. Have you deliver training on beekeeping for beekeepers? 1/ Yes 2/ No
3. Does the district establish beekeepers' cooperative on beekeeping that facilitates the marketing network for beekeepers? 1/ Yes 2/ No
4. Which types of beehives beekeepers use most of the time for honey production in the kebele you are working?

A. Traditional

B. Transitional

C. Modern

5. What is the status of honey production of the kebeles you are assign to support it professionally in 2017 E.C?

Thank you very much for your cooperation

4. APPENDICES **4**. Photos indicates types of beehives used by beekeepers in HidabuAbote District



Traditional hive



Modern hive



Transitional hives