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ASSESSING HONEY PRODUCTION PRACTICES AND FACTORS AFFECTING ITS PRODUCTION IN GOHATSION DISTRICT OF NORTH SHEWA ZONE,OROMIA REGIONAL STATE, ETHIOPIA

A THESIS SUBMITTED TO THE POSTGRADUATE PROGRAMS OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN BIOLOGY.

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Declaration

I declare that this thesis is my original work and that all sources of materials used for this thesis have been duly acknowledged. I solely declare that this thesis was not submitted to any other institution for the award of any academic degree or diploma certificates.

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Signature_____

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ADDIS ABABA UNIVERSITY

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This is to certify that the thesis prepared by Tadesse Ketema entitled "Assessing honey production practices and factors affecting Honey production in the Gohatsion District of North Shewa Zone, Oromia Regional State, Ethiopia" and submitted in partial fulfillment of the requirement for the Degree of Master of Science in Biology.

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Examiner:

Chair person:

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Acronyms/Abbreviation

AGP_ Agricultural Growth Program

EARO_ Ethiopian Agricultural Research organization

ETB_ Ethiopian birr

E.C – Ethiopian Calander

GDP_ Gross Domestic Products

HBRC_ Holeta Bee Research Centre

HHs_ Households

MoARD_ Ministry of Agricultural and Rural Development

NGO_ Non-Governmental Organization

SPSS_ Statically Package for Social Sciences

Abstract

In Ethiopia, honey production was a traditional occupation widely practiced by farmers as a supplementary income-generating activity. However, an inefficient agricultural marketing system coupled with traditional production methods hinders beekeepers from optimally benefiting from honey supply.The objective of the study was to assess honeybee production practices and factors affecting Honey production in the Gohatsion district,North showa Zone,Oromia regional state.The district stratified into three Agro-Ecologies, and a stratified random sampling procedure was followed to select the peasant association based on their agro-ecological zones. For this study,three Kebeles were purposefully selected, focusing on climate variability and its impact on honey production. A total of 120 respondents from those Kebeles were selected by discussing with experts, considering the farmer households who depend for their livelihood on honey production. Both primary and secondary data collection methods were used for this research, and the primary data were collected by direct investigation by the researcher to observe the status of honeybee colonies per household. The researcher used computer software packages such as Ms. Excel 2007-and SPSS to analyse the data.

Beekeeping in the study area was predominantly practiced by males, and about 83% of interviewed households were married, while the remaining 17% were single.Traditional, transitional, and modern frame hives were the three types of honeybee production systems, in which 40.8% of the respondents used only traditional hives, 10.8% used traditional and transitional hives, 24.2% used traditional and modern hives, 4.2% used transitional hives only, 5.8% used transitional and modern hives, 5% used modern hives only, and 9.2% used traditional, transitional, and modern frame hives. The average annual honey yields per hive per year from traditional beekeeping in the mid-land were higher than in the highland and lowland. The average annual honey yields per hive from traditional, transitional, and modern bee hives were 6.5kg, 10 kg, and 14 kg/ hive types respectively.The major factors that affected the honeybee production in the study districts were: pests and predators, high cost of modern hives and accessories, misuse of agro-chemicals, honeybee diseases, poor management, and shortage of bee forage, honeybee colony, and absconding of bees. The major pests and predators include ants, wax moth, honey badger, termites, hive beetles, spider, lizard, and bee-eater birds. To sustain the beekeeping activity, there should be the introduction of affordable and appropriate beekeeping technologies with all accessories, strengthening the appropriate beekeeping management practices, and finally mobilizing women and beekeepers into the sub-sectors through training. Furthermore, large-scale and comprehensive research on constraints and honeybee diseases were highly recommended to set appropriate solutions.

Key words: Honey production, Honeybee, Beekeeping, type of hive, households, Risk Factors, Disease, pests, Gohatsiyon District

CHAPTER ONE
INTRODUCTION

1.1. Back ground of the study

Honey, a natural sweetener, is produced by *Apis mellifera* (Linnaeus, 1758) from the nectar of plants. It was a nutritious food that includes various sugars, proteins, free amino acids, trace elements, minerals, vitamins, water, and enzymes, and was known for its high caloric value. The primary sugars in honey were fructose, glucose, and dextrose, which were quickly absorbed into the bloodstream to provide immediate energy (White, 1980). Throughout history, honey has been used for medicinal purposes, as food, and in religious and cultural rituals (McInerney, 1990; Molan, 1999). Beekeeping requires relatively small amounts of land, modest budgets, and basic technical skills. It offers tangible benefits such as material goods, income, well-being, and personal satisfaction (Nicola, 2009).The potential for honey production to drive development was significant across nearly all African nations. Beekeeping has a long history in the country, where it was traditionally been practiced by rural communities as a supplementary activity for producing honey and beeswax, which helps to generate income.Ethiopia boasts some of Africa's richest biodiversity,with it was forests and woodlands hosting a wide variety of plant species that offer abundant nectar and pollen for bees (Girma, 1998; MoARD, 2013).The country was home to the largest number of bee colonies in Africa and produces approximately 24,000 tons of honey annually, representing 24% of Africa's and 2% of the world's honey production. Ethiopia was estimated to have over 7,000 species of flowering plants, many of which were vital to honeybees (Girma, 1998).

The northern part of the Oromia region is known for its diverse vegetation, cultivated crops, and strong potential for beekeeping. In the Gohatsiyon district, which is located in the northern Oromia region, livestock, mixed cropping, poultry, and honeybees are key indicators of the local agricultural wealth. Beekeeping, a sustainable and ecologically friendly farming practice that does not compete with other agricultural activities or conservation efforts, has the potential to significantly contribute to food security in drought areas.

In Gohatsiyon District, many areas that are unsuitable for agriculture are covered with a variety of trees, shrubs, bushes, and wildflowers, which makes the region ideal for beekeeping. However, for beekeeping to be effective and sustainable, it is important to address various

challenges associated with it. Currently, there is no comprehensive or reliable data on honey production in Gohatsiyon District, including details on the number of beekeepers, bee colonies, honey output, types of beekeeping practices, and existing constraints. This study aims to gather crucial information on the beekeeping production system, productivity, and challenges in Gohatsiyon District. It is essential to assess and document this information, as it has not been done before in the district.

The beekeeping sector in Ethiopia faces several significant challenges, including bee behavior issues (such as aggressiveness, swarming tendencies, and absconding), a lack of skilled labor and training resources, outdated technology, the high cost of modern beekeeping equipment, and environmental issues like drought and deforestation. Other constraints include poor postharvest management and marketing of beehive products, the misuse of agrochemicals, honeybee diseases, pests, and predators, inadequate extension services, and poor coordination among research, extension, and farmers, a shortage of records and current data, and insufficient research institutions to tackle these problems. However, these issues may vary in severity across different regions of the country (HBRC, 1997; Ayalew, 2001; Edessa, 2005).Bees in Ethiopia are known to suffer from various pathogens, including fungi, viruses, bacteria, and protozoa. Research has identified several honeybee diseases in the country, such as Chalk brood, Nosema, and Amoeba. Additionally, pests and predators affecting bees have been documented in various regions (FAO, 1986) In particular, Gohatsion district in North Showa, Oromia regional state, has very little available information on honey production systems, their utilization, and associated constraints. Updated data was crucial for capitalizing on opportunities within the honey sector, devising effective interventions to address challenges, and identifying harmful diseases, parasites, and pests affecting honey bee colonies.

1.2. Statement of the problems

Honey production and beekeeping have long been integral to Ethiopian farming communities, providing both additional income and nutritional benefits for many subsistence farmers. Gohatsion district, known for its abundant natural resources, including rich vegetation, ample water, and favorable climate, is well-suited for apiculture (Sahle et al., 2018).However several challenges hinder the development of the honey industry in the district. These issues include pests and chemicals such as herbicides and insecticides, diseases, deforestation, inadequate

training, improper hive placement, reliance on traditional technologies, and poor management of bees and hives.

Overall, there were numerous obstacles preventing beekeepers from achieving optimal honey production.This study aims to investigate the factors limiting honey production in Gohatsion district, North Shoaw, Oromia Regional State, with the goal of addressing these challenges and enhancing the sector's potential.

1.3 Objectives

1.3.1 General Objectives

The general objectives of the study was to evaluate the honey bee production system and identify the factors affecting honey bee production in Gohatsion district, North Shewa Zone, Oromia Regional State,northern Ethiopia

1.3.2 Specific objectives

1- To assess honey bee production practice in the Gohatsion district.

2- To determine types of hives used in honey production in the study area.

3- To analyze the annual honey yields from different types of hives.

4- To identify potential risk factors that affect honey bee production in the study area.

5-To analyze opportunities of beekeeping practices in the study area.

1.4. Research questions

1-What are the beekeeping practices used by beekeeper in the study area?

2-What kind of hives do people use and its effect on the quality of honey production in the study area ?

3-What are the factors that limit honey production in the study area?

4- To assess challenges and opportunities of apiculture in the study area?

1.5 Significance of the study

Beekeeping requires minimal capital investment and does not necessitate large land areas or imported inputs. It also plays a crucial role in enhancing livelihoods and supporting ecosystems through the cross-pollination of plants. The study district is recognized as a promising area for honey and other beekeeping products.

This research is valuable as it examines the honey production system, identifies constraints, and offers specific insights and recommendations for improving honey production practices. It highlights critical areas needing attention and suggests topics for further research. The findings

could serve as a guide for future honey production efforts in the region and district, providing a structured resource for additional research, extension services, and development initiatives.The results can inform government and non-governmental organizations interested in investing in beekeeping. Researchers and extension workers can use this information to refine their approaches and enhance honey production technologies.

Additionally, policymakers can leverage these findings to develop suitable agro-ecological policies that support beekeeping, benefiting both governmental and non-governmental stakeholders involved in this sector.

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin, Evolution and Distribution of honey bees

There was very little information about the ancestor of bees as the fossil record was extremely scarce Grimaldi, D. (2009).However, it is supposed that first bees evolved from wasp like ancestor known as spheciod about 100 million years ago in Gandawana during mid-cretaceous period Culliney (1983).This was the time when the evolution of angiosperms had taken place Axelrod,D.I.(1952).However honey bees and humans have been crossing paths for millions of years. Indeed our early ancestor likely raided wild bee colonies for honey, much as Chimpanzees do today (Hicks et al.,2005).The honey bee *Apes mellifera in* African has three species with slightly different morphometric (Crewe et al., 1994).High altitude areas at about 2500m and above were inhabited by the sub-species, *Apis mellifera* monticoam mountain honey bee. Low altitudes, such as coastal areas of East Africa, were populated by small sized honey bee sub-species *Apis mellifera litorea* (Smith, 1961).Mid-altitude areas were populated by *Apis mellifera* scutellata, which are morphometrically similar to *Apis mellifera* litorea (Radloff and Hepburn, 1997).Geographical races were distinct unit, representing different genotypes adapted to different environments. Recent studies indicated that there were about 23 *Apis mellifera* honeybee races of which 12 of these found in Africa.

2.2. Honey Production

Honey, the natural product of honeybee, It is an excellent energy source because it contains simple sugars that are ready for assimilation immediately on reaching the intestine.Honey color and flavor vary based on the nectar collected by the bees. In Ethiopia, much honey has traditionally been fermented to make 'Tej'.(Bahiru, B 2001).

2.2.1. Honey Production in Africa

Both humans and honeybees originated in Africa, each species migrating out of the continent on several occasions. Early people took honey from hollow trees found in the forest.The first beekeepers were hunters, seeking out wild nests of honeybees, which often destroyed to the sweet reward called honey. Honeybee originated in Africa and spread into Europe and Asia (Cridland et al., 2017)

European honeybees were introduced into North America in the early 1600‟s primarily for honey production Meixner (2010).According to Moritz et.al (2005.*Apis. mellifera* occurs naturally in a great range of habitats and climatic zones 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 has 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 Kenya, Ethiopia, Tanzania, Uganda and Rwanda.Ethiopia is the largest producer of honey in Africa and produces approximately 45,300 tonnes annually Nurhussien(2016).Tanzania is the second largest producer, approximately 8,000 tonnes annually, and Kenya ranks third in followed by Uganda and Rwanda, with just 4,000 tonnes a year (Hussein, 2000).

2.2.2. Honey production in Ethiopia

Ethiopia is a leading honey producer in Africa and one of the ten largest honeys producing in the world.It has a comparative advantage for apiculture. There are over 7000 melliferous plant species in Ethiopia (Tahir et al., 2023).All these produce significant amounts of nectar and pollen which makes them appearing to bees. Due to bimodal rains, honey can be harvested at least twice a year.It was estimated that more than 2 million bee colonies exist in the forests and crevices in Ethiopia Arega & Guddata (2021).According to Mohammed and Hassen (2021), Ethiopia has the potential to produce up to 500,000 tons of honey and 5,000 tons of beeswax per annum.

Honey production in Ethiopia has a potential to strength the Ethiopian economy, reduce poverty, and conserve forests. The honey produced in Ethiopia was expected to become a major commodity for acquiring foreign currency to improve the Ethiopian economy.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. Beekeeping can also be supplementary to crop production by facilitating pollination (Wilson, 2006). In Ethiopia, more there are two honey-collecting seasons: the major one is carried out from October to December and the second one from April to May Tarekegn et al.(2017).There are a number of factors that limit honey production in Ethiopia such as climate change, deforestation, and invasive species that reduce their quality of health and longevity (UNEP, 2010). People who are less educated in honey practices,harvest little honey yields Yahaya and Usman (2008).When the colony is not well fed, it will leave the area at the

same time affect the yield. types of honeybees can be identified in different ecological systems, *Apis mellifera aadansanii, Apis mellifera jementica, Apis mellifera litorea, Apis mellifera abyssinica, and amillifera monticola* (Amsalu et al.,2004).Among those, *Apis mellifer abyssinica* was the famous one in the country.

2.2.3. Honey Production in Oromia

Oromia regional state holds a significant share in the country's honey production. According to the Central Statistical Agency (CSA) in 2003, the regional contribution to honey production in Ethiopia is distributed as follows: Oromia (41%), SNNPR (22%), Amhara (21%), Tigray (5%), and other regions together (11%).The Oromia region is endowed with abundant natural resources favorable for honey production activities. These include a diverse array of plant species, reliable water sources, dense forests, oil crops, grain crops, suitable climatic conditions, and a variety of shrubs and herbs. This favorable agro-ecological environment and climate conditions support the high reproduction and survival of bees, leading to the production of quality bee products.

2.2.3.1. Honey production in the study District.

Gohatsion district, known for its abundant natural resources, including rich vegetation, ample water, and favorable climate, is well known in honey production activities.But, the method of honey production in this district is mostly traditional, which involves traditional hives.

because district livestock Fishery Development office should not give enough attention by giving sufficient training and continuous assistance for the beekeepers. The disadvantage of this hive was it is not favorable to increase quantity and quality of honey produced because there is no possibility of having partition ship for honey and brood and no standard dimension regarding their length and their diameter, inconvenient to inspect and the bee construct irregular comb, which was difficult to harvest.in traditional honey production, the hive condition, affect the honey, wax and bee colonies (Gichora, 2003).

2.3.Honey production systems

Beekeeping, also known as apiculture, involves the managements and care of bees for the production of honey, beeswax, pollen, royal jelly, and other products. The beekeeping practice was started with traditional and later developed through introduction of the intermediate hives and modern hive. Each hive with its unique characteristics and objectives. Moreover, the advance of beekeeping led to introduction of frame hives and modern hive to increase the

quantity and quality of the honey until the present (HBRC,1997).The development of beekeeping was overviewed as follows;

2.3.1 Traditional system beekeeping

In Ethiopia, traditional beekeeping is the oldest and the richest practice, which has been carried out by the people for thousands of years (Bahita,T. 2018).About several million bee colonies are managed with the same old traditional beekeeping methods in almost all parts of the country (Bahita,T.2018).Traditional beekeeping is of two type: forest beekeeping and backyard beekeeping.In other most parts of the country backyard beekeeping with relatively better management is common (Nuru, 2002).The types of hives and the way of keeping bees vary from area to area. Based on locally available materials used for construction of hives, environmental conditions and positions used to keep bees, the following variants of basic design are found throughout the country: hollowed logs, bark hive, bamboo or reed grass hive, mud (clay) hive, animal dung (mixed with ash) hive, woven straw hive, gourd hive, earthen pot hive and so on Segni Shimelis(2017).The beekeepers that are experienced and skillful in using these hives could do many operations with less facility. Gezahegne (2001) stated that under Ethiopian farmers' management condition, the average amount of crude honey produced from traditional hive is estimated to be 5 kg / hive / year. Traditional husbandry is practiced with many millions of fixed comb hives particularly in the remote areas of the country. For the period until modern frame-hives were introduced, these fixed comb hives can yield a moderate amount of honey, and also about 8-10% of its weight was beeswax. This harvest was achieved with minimal cost and labor, and it was valuable to people living a marginal existence.

2.3.2. Transitional system of beekeeping

Intermediate hives are made from timber and other locally available materials. It has atop bars on which honeybee attach their combs. The main advantage of this hive is that easy to inspect the internal problem of the hives, to avoid damaging of brood during harvesting of honey and easy to open(HBRC,2004)

2.3.3. Modern (improved) system of beekeeping

The quantity and quality of honey produced in this type of hive is better than transitional and traditional hive because this type of hive has queen excluder,brood chamber and honey chamber, seasonal inspection, centrifugal honey extractor and possible to move swarm from place to place for searching bee forage and pollination service.it uses different types of frame hives.practical

movable-frame hive was invented in 1851 by Lorenzo Lorraine Lang troth in U.S.A(Vivian,1985).In Ethiopia,movable frame hives were introduced since 1970 (HBRC,1997) and the most common frame hives being used in our country are Zandar and Langsroth style hives. Others such as Dandant,foam hive and modified Zander is rarely used(HBRC,2004)

However, lately some regional states have paid significant attention to the demand the recent distribution status of frame beehives was increasing (Belets Gebremicheal and Berhanu Gebremedhin, 2014).but were likely require high investment cost and trained man power.

2.4. Opportunities of Beekeeping Practices in Ethiopia

2.4.1 Agro-ecology and diversity of flowering plants

Ethiopia has a potential in beekeeping because of growing of different vegetation and crops which were a good source of nectar and pollen for honeybees in the country. Large and diverse botanical resources combined with suitable climatic conditions make it conducive for the beekeeping business (Desalegn, 2015). In Ethiopia, there are about 7000 species of flowering plants upon which the bees feed and collect important raw materials necessary to make honey and other hive products Olana & Demrew (2019).Due to this suitable natural environment, around 10 million honey bee colonies exist in the country (EIAR, 2017)

2.4.2 Floral calendar of honeybee plants

Beekeeping plays an important role in protecting the country's natural resources and the national economy. Bees and flowering plants have interdependencies that strengthen coevolution. For all management activities in beekeeping, for example creating flower calendars are important tools. Identification and documentation of productive bee forages and their flowering calendars are important for beekeeping activities to increase its production.

Floral calendar for beekeeping is a time-table that indicates to the beekeeper; the approximate date and duration of the blossoming periods of the important honey and pollen plants .When we see the flowering time of single species, it begins from the full opening of the first few buds till, the start of fruit formation end of flowering .The distribution and type of honeybee plants as well as their flowering duration vary from one place to another place due to variation in topography, climate and farming practices. Hence, every region has its own honey flow and floral dearth periods of short or long duration and this knowledge on bee flora helps in the effective management of bee colony during such period. In Ethiopia honey flow period was after the heavy rain in June through September known as"Kiremt" and most of the Ethiopian highlands

are coloured with golden-yellow because of abundance of flower of bidens species (Tessega Bile, 2009). Establishing flowering calendar of honey plants that enable effective seasonal colony management is paramount important.

2.5. Economic Importance of Beekeeping in Ethiopia

Beekeeping in Ethiopia has a long-standing cultural agricultural practice. Beekeeping is a deep rooted practice in the rural communities of the country and it has been and still plays a significant role in the national economy of the country as well as for the subsistence smallholder farmers.Beekeeping has many advantages that help farmer beekeepers to improve their wellbeing (BoARD, 2010).The socio-economic impact of beekeeping and the main hive products and importance of beekeeping were summarized as follows: honey, the natural product of honeybee, has many times been described as man's sweetest food. It is an excellent energy source because it contains simple sugars that were ready for assimilation immediately on reaching the intestine.In Ethiopia, honey was almost used for local consumption, and to a very large extent for brewing of mead (tej).Almost on wedding or other cultural, religious and social events cannot be imagined without the honey wine 'Tej' in the past (Beyene and David, 2007).

2.5.1. Medicinal value/traditional medicine

Honey primarily seen in traditional medical systems as having curative properties; this derives from the fact that honey made from particular medicinal plants (FAO, 2009), on a topical application honey has demonstrated accelerated wound healing in animals. In terms of beeswax, claims were made that it has antibiotic properties and can be used for arthritis and nasal inflammation (FAO, 2009).

Honey contains a nutritional value like: - antioxidants, minerals, vitamins, proteins and a high caliorificial value, which present attractive ingredients that do not occur in artificial sweeteners (Alkire and Foster, 2011).

2.5.2. Crop pollination

Beekeeping sustains agriculture, which was the livelihood of the rural community by increasing yields through pollinating annual and perennial crops. It offers a good way for people to create income from natural resources without damaging.it provides services of pollinating crops. Beekeeping activity, besides the production of honey and other bee products, has a positive contribution for cross-pollination, which would bring sustainable contribution to the agriculture

and economy of the nation (Rucker, 2012).Golden service of bees is not recognized in Ethiopia and even in Africa as well (Dekebo,2019)

2.5.3. Job opportunities

Beekeeping practices create job opportunities for land less men and women for their livelihood as it needs low capital to start. It could also be observed that many people (intermediaries and traders) participate in honey collection and retailing (at village, district and zonal levels).it can also serve as job opportunities to local carpenters and organized youths in construction of bee hive.

2.5.4. Export

Honey and beeswax are among agricultural products that contribute to the national economy through export earnings. There is an opportunity for Ethiopia to benefit from honey exports as result of its large and diverse flora resource for large-scale honey production Gebretsadik & Negash (2016).There is also possibility to supply different flavors' of honey throughout the year. Ethiopia exported honey to European country, U.K.was 30 tons in 2008 others (Demisew, 2016).Currently, the export had reached up to 900 tons per annum (FDRE, 2016).And,from this how much for high

Currency is obtained per year.

2.6. Honey bee Constraints in Ethiopia

The major constraints in the beekeeping sub sector in Ethiopia is the behaviors of bees Swarming, absconding and aggressiveness characteristics(Nurie, 2020).lack of skilled man power and training institutions, drought and deforestation of natural vegetation, high price of improved beekeeping technologies, low level of technology used, poor post-harvest management of beehive products and marketing constraints, pest and predators, poor extension services, honey bee disease, indiscriminate application of agrochemicals, poor extension services, absences of coordination between research, extension and farmers, lack of access to credit services and weak road and market infrastructures in production areas, shortage of records and up-to-date information and inadequate research institutions to address the problems.Nevertheless,all these problems may not be constraints to all parts of the country and may not be equally pressing to every place (Edessa,2005)

2.6.1. Effect of land degradation and fragmentation

Landscape fragmentation and habitat loss at multiple scales directly affect species abundance, diversity, and productivity.Remot-sensing-based landscape variables were linked to honey bee colony strength variables in a typical highly fragmented smallholder agro ecological level (Wilson et.al. ,2018).There is on honey production globally, the agriculture land scope has gone through large changes because of land use conversion and intensification (Shepherd et al., 2003). In Ethiopia, the land which the farmers used for livestock feed was converted in to crop lands and settlement due to increase in human population(Eferem et.al.,2010).With regard to honeybees, habitat degradation and fragmentation lead to decrease in habitat quality for food and nesting sites.

2.6.2. Use of Agro-chemicals (Herbicides and Pesticides)

The use of pesticides and herbicides is increasing from time to time due to their significant importance in maximizing crop production. This situation raised concerns about their potentially adverse effects on honeybee health and the environment. When different chemicals are applied to the crop pests, weeds, tsetse fly, mosquitoes and household pests they are affecting the pests of the crop but also harm the beneficial insects as pollinators, predators and parasites. This harmful effect disturbs the natural balance between the insects and their natural hosts (Moreno, R. 2009).

The chemicals used for crop protection were the main pesticides that kill the bees. On the other hand, herbicides, which are commonly not toxic to bees, destroy many plants that were valuable to bees as source of pollen and nectar Sanchez (Goka , 2016)The types of chemicals used include Malathion, Glyce, Mancozeb, Diazinon, Dimethoate, Sevin, DDT, 2-4 D and Acetone. As it is seen from the beekeeper point of view, poisoning of honeybees by agrochemical has increased from time to time,Some beekeepers lost totally their colonies due to agrochemical (Kerealem et al., 2009).

CHAPTER THREE

MATERIALS AND METHODS

3.1. Description of the study area

The study was conducted in the Gohatsion Districts of the North Shewa zone, which is located in the Oromia National Regional State (figure.1)The district consist of 32 kebeles, where the rural areas have 29 farmers associations and three urban area (including Filiklik, Gohatsion, and Tullu Milki).The main town of the district is Gohatsion, situated 73 km from the zonal capital of Fiche and 185 km north of Addis Ababa.The district is bordered to the north by the Abay River, which separates it from the Amhara Region, to the south by Kuyu, to the east by Hidabu Abote, to the northeast by the Jamma River, which separates it from Dera, and to the west by the Muger River, which separates it from the West Shewa zone. The astronomical location of the district is approximately 9 degrees 47' to 10 degrees 11' N and 38 degrees 27' to 38 degrees 43' E latitude and longitude, respectively. The total area of the Gohatsion district was 1207 km2, making it the second-largest district in the North Shewa Zone. The major rivers of the district are the Abay, Jema, and Muger. The period of long rainfall occurs from June to September, and the short rainfall occurs from April to May, with the peak records usually in July and August.

The mean annual rain-fall is erratic in distribution and varies between from 800 mm to 1400 mm with the average minimum and maximum temperature was 21^0c to 27^0c. In 2023, the District Agricultural and Rural Development statistically reported that a total population was 161,464 with the proportion of 82,156 males and 79,308 females. The two largest ethnic groups reported in Gohatsion are the Oromo (79.22%), and the Amhara (20.63%), all other ethmic groups made up 0.15% of the population.Afan oromo is spoken as a first language by 80.26%, and 19.67% spoke Amharic, the remaining 0.07 spoke all other primary languages reported. The majority of the inhabitants professed Ethiopian orthodox Christianity with 89.75% of the population reporting they practiced that belief, while 6.52% said they were protestant, and 3.73% of the population were muslem.Climatically, the district was categorized in to three Agro-ecological Zones, These are high land (Dega) which accounts for 33%, Mid-land (Woina-dega) which accounts for 34%, and low land (kolla) covers 33% of the districts. The primary soil types found in the region were black soil in the highlands, red soil in the mid-elevation areas, and a mixture of soil types in the lowlands. The main crops grown in the area included chickpea, lentil, wheat,

teff, barley, finger millet, sorghum, maize, field pea, common bean, and fruits like mango, avocado, and banana. A mixed cropping and livestock farming system are the predominant agricultural practices in the region. The study area is selected purposively because the region is renowned for honey production and faced numerous challenges in the honey production process.

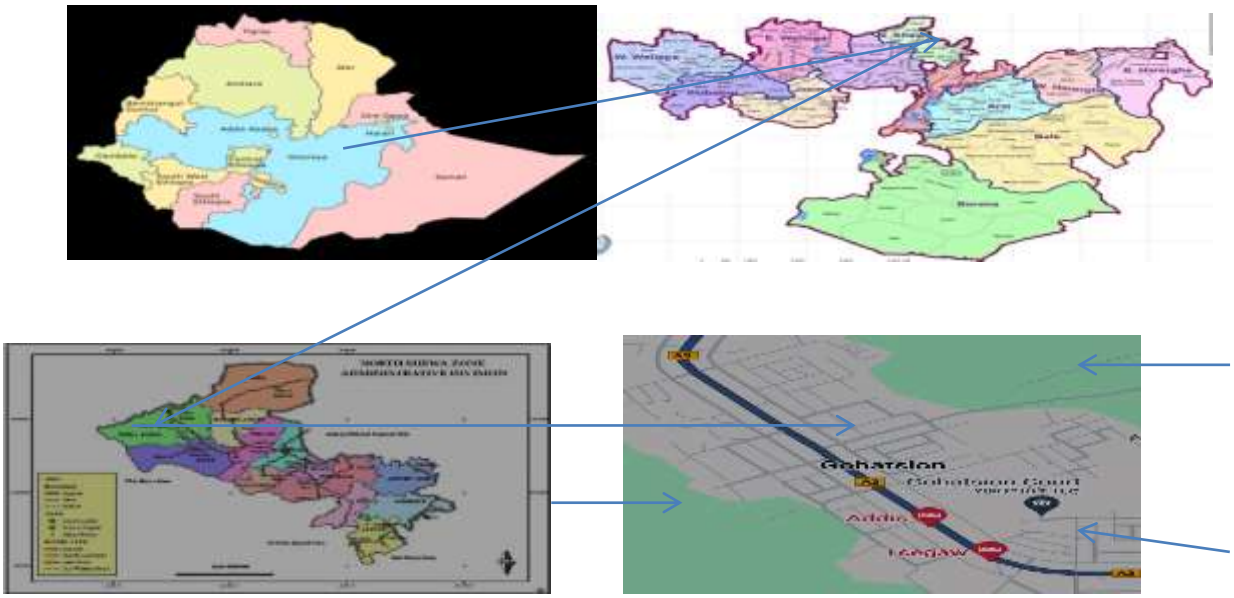

Figure 3.1: Map of the study area

3.2. Sampling procedure and Sample Size

To collect data relevant to the research problems and objectives, the researcher employed a multi-stage sampling approach. Initially, the study area, which comprised 32 kebeles (the smallest administrative unit) in the district was considered. At the first stage, four kebeles were purposively selected based on their agro-ecological zones: Wale Chilalo from the highlands, Kare Qunde from the midlands, and Filqliq from the low lands. From the selected kebeles, a total of 120 households were included in the study, with 40 households chosen from each of the three agro-ecological zones. The selection criteria were based on the households' level of involvement in beekeeping and their potential for beekeeping, as determined by the district's agriculture and rural development experts, who assessed the households' experience in keeping honey bees and their participation in extension services.

The development agents from the respective kebeles identified the households with experience in beekeeping and involvement in extension services. In this study, a single household respondent, the person responsible for managing the beekeeping activities, was used as the sampling unit.

3.3. Data collection methods.

The data collection process involved structured interviews, supplemented by visual observations.Primary and secondary sources were leveraged to address the study objectives and research questions. Primary data were gathered through formal interviews with household members engaged in beekeeping activities, as well as key informants, using a semi-structured questionnaire. The questionnaire, initially drafted in English, was translated into Afan oromo to accommodate beekeepers and livestock experts who may not be literate in the former.

The questionnaire was designed to capture data on household profiles (gender, age, family size, education level), honey production methods (number and types of hives, beekeeping equipment), honey harvesting seasons, apiculture constraints, annual honey yields, honey bee floral sources, honey flow seasons, training and support provided to beekeepers, hive placement, presence of toxic plants and pests, strategies to overcome limiting factors, and the impact of agrochemicals on honey production. Additionally, the questionnaire explored the pricing trends for honey over the years in the study area prior to the main survey. A pilot study also conducted to pre-test the questionnaire and record sheets. Feedback from this stage was used to refine the questionnaire.

Secondary data were obtained through document analysis, including a review of books, theses, internet resources, magazines, unpublished reports, and files from the Gohatsion district agricultural development office. This complementary information provided in-depth insights related to the identified research problem.

3.4. Method of sampling and sample size

In order to collect data related to the research problems and research objectives the researcher followed different stage technique of sampling. Accordingly, in the study area there were 32 kebeles exist in the district, at first stage, three kebeles were purposively selected out of the 32 kebeles with the criteria of having relatively large number of participants in beekeeping and potential for beekeeping with the help of district agriculture and rural development experts. The purposively selected kebeles were wale chilalo from high land,kare qunde from mid land,and filqliq from low land. Accordingly, in wall chilallo 58 beekeepers, in kare kund 61 beekeepers, and in filqliq 53 beekeepers have presented in kebeles.in the second stage, by using the population list of beekeepers in the sample kebeles 40 beekeepers equally take from each selected kebele, Such that each stratum was made up of kebele sharing similar characteristic. as a total 120 beekeepers(households) selected for the household survey(i.e 3kebeles*40

households).The selection was made by using simple random sampling techniques.The list of beekeepers households obtained from Development agents in each kebeles were used as a sample frame

3.5. Methods of data analysis

The data collected from the sampled respondents were coded, tabulated, and processed for statistical analysis. The cleaned data were then stored in a Microsoft Excel program for further analysis. The data were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 21, employing simple descriptive statistics such as tables, percentages, frequencies, ranges, means, and standard deviations. Any items that could not be captured through quantitative analysis were examined based on open-ended questions including interviews and group discussions with beekeepers and extension workers

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 RESUSLTS AND DISCUSSION

4.1.1 Socio-demographic characteristics of households

4.1.1.1 Gender of the respondent

In this survey result 85.8% of the respondents were males and the rest 14.2% were females. From house holder sampled of the respondents 49.1% of them were in age range of 21-45 ages, 34.2% of the total respondents were between 46-60 years old, about 16.7% of the respondents were greater than 60 ages. The marital status of respondents in this study area, about 74.2% of house holder the respondents were marred, whereas 25.8% of the respondents were single.

Out of the total respondents of households about 22.5% could not read and write(illiterate),about 49.2% of the respondent were able to read and write, about 25% of the respondents were grade 1-8,about 3.3% of the respondents were attended grade 9-12(Table 4.1)

Table 4.1:- Socio-demographic characteristics of respondents in Gohatsion district, central Ethiopia

Description	Respondents	Frequency	Percentage
Gender	Male	103	85.8
	Female	17	14.2
Age	21- 45	59	49.1
	46- 60	41	34.2
	>60	20	16.7
Marital Status	Married	89	74.2
	Single	31	25.8
Educational Levels	Illiterate	27	22.5
	Read & write	59	49.2
	1-8	30	25
	9-12	4	3.3

n= number of respondents

4.1.2 Types of beehives used by beekeepers

Based on the information gathered from the respondents, there are three types of beehives used for honey production in the study area, namely traditional, transitional, and modern hives. The survey result indicated that about 40.8% (32.5% in high land, 37.5 % in mid land and 52.5% in low land) of the beekeepers in the study area use only traditional types of beehives,4.2% (5% in high land,2.5% in mid land ,5% in low land) use only transitional types of beehives, and 5% (5% in high land,7.5 % in mid land, and 2.5% in low land) use only modern types of beehives(Table 4.2).

Howeve,10.8% (10% in high land, 10% in mid land and 12.5% in low land) of the beekeepers use traditional and transitional bee hives, and 5.8%(5% in high land,7.5% in mid land,5% in low land) transitional and modern beehive beekeeping, while 24.2% (32.5% in high land, 27.5% in mid-land and 12.5% in low land) of the beekeepers in the study area use both traditional and modern frame hives, and 9.2%(10% in high land,7.5% in Mid land,10% in low land)use traditional, transitional and modern hive beekeeping at the same time. It was also observed that the beekeepers used locally available materials and indigenous knowledge to make traditional, transitional and modern beehive in the study district.

This study is in agreement with Getachew Abreham (2018), who reported traditional, transitional and modern beehives were used for the honey production in Gesha district, south-west Ethiopia. However, disagreed with Haftu and Gezu (2014) who reported that about 41% of the beekeepers of the central zone of Tigray used both traditional and modern beehives and the rest 27.7%, 30.1% and 1.20% only owns traditional, modern and transitional beehives, respectively.

The main reasons for low adoption rate of modern bee hives and transitional beehive in the study area could be lack of finance to buy beehive,not enough attention by giving sufficient training and continuous assistance for the beekeepers,and absence of accessory equipment to improved beehives in the study area. Even if, beekeeping has significant economic contribution for sustainable development for the region, the attention given to the sector until recently was not satisfactory and beekeeping has been left for nature with the little attempts to support it with technological packages to improve its production and productivity.

Table 4.2 hive types used by beekeepers in the study area

Types of hives	High land (n=40)		Mid land (n=40)		Low land (n=40)		Total (n=120)	
	n	%	n	%	n	%	n	%
Traditional only	13	32.5	15	37.5	21	52.5	49	40.8
Transitional only	2	5	1	2.5	2	5	5	4.2
Modern only	2	5	3	7.5	1	2.5	6	5
Traditional and Transitional	4	10	4	10	5	12.5	13	10.8
Transitional and Modern hives	2	5	3	7.5	2	5	7	5.8
Traditional and Modern hives	13	32.5	11	27.5	5	12.5	29	24.2
Traditional , Transitional and Modern hives	4	10	3	7.5	4	10	11	9.2

n=Number of respondents

4.1.3 Honey bee management practices

4.1.3.1 Placements of honeybee colonies

According to the survey result,12.5% of the beekeepers in the study area placed their traditional hive hander the roof of the outside part of house wall.in the same manner, about 7.5% of respondents also placed their hive at backyard in open space hanged up on long tree.while 22.5% (10 % traditional hive, 5 % transitional hive, and 7.5% modern hive) placed their hive at backyard under simple shelter made for this purpose, whereas 57.7 % (27.7% traditional hive,12.5% transitional hive, and 18.3% modern hive) beekeepers placed at backyard around the home in open space (Table 4.3)

Table 4.3.Placement of beehives after getting colony (%) in Gohatsion district by sample respondents

Beehive placements	Placement hive types that possessed by respondents							
	Traditional hive		Transitional hive		Modern hive		Total hive types	
	n	%	n	%	n	%	n	%
Hander the roof of the outside part of house wall	15	12.5	-	-	-	-	15	12.5
Backyard in open space hanged up on long tree	9	7.5	-	-	-	-	9	7.5
Backyard under simple shelter made for this purpose	12	10	6	5	9	7.5	27	22.5
Backyard around the home at open space	32	26.7	15	12.5	22	18.3	69	57.5

n=Total number of the hives


Figure 4.1 placements of beehives in the district by sample respondents

4.1.3.2 Sources of honeybee colony

The survey result indicated that,14.2% gift from family,20 % buying, and 65.8 % catching bee swarms(Table 4.4).This finding is agreement with Chala (2010)who reported that the majority of the beekeepers initiated beekeeping through swarm catching in Gomma district of Oromia Region. From this finding it can be observed that beekeepers in the district spent much time on catching swarm to establish beekeeping activity, because of the fact that obtaining bee colony free of charge.

Table 4.4. Source of honey bee colonies in the study area.

Sources of honey bee colony	Frequency	% of respondents
.Gift from family	17	14.2
.Buying	24	20
.Catching bee swarms	79	65.8

4.1.3.3 Beekeeping training

Table 4.5.demonstrated that about 84.2% of the respondents did not take any kind of training.only about 15.8% of the respondents received training. Almost all beekeepers faced honey production problems

Table 4.5: Training services on honey production

Have you got training on honey production?	Frequency	Percentage
Yes	19	15.8
No	101	84.2
Total	120	100

4.1.3.4 Honey Harvesting Season

In the study area there were two phases of honey harvesting period: the most known of the beekeepers harvesting period is November and the minor one May which are similar with the results of Chala et al (2013) who reported from Goma district.However, in addition to these major harvesting periods, there were many small harvesting periods which depend on the type of flowering plant, and environmental condition in different agro ecologies, which experienced beekeepers easily associate the harvesting season with the botanical origin of honey in their locality.

Table 4.6. demonstrated that for the respondents provided question on what season honey production is most successive and yielded high, Most of them responded that honey was highly harvested in October, and December than the other month's. About 96.7% (92.5% in high land, 97.5 in mid land ,and 100% in low land) of the respondents collect good honey yields during autumn(September, October, November),while 12.5% (5% in high land, 10% in mid land and 22.5% in low land) of the respondents collect honey from their hive during winter (December, January, February),and 70.8% (47.5% in high land, 77.5% in mid land and 87.5% in low land) of the respondents collect their honey during spring season, while 9.2% (7.5% mid land, and 20% low land) of the respondents collect their honey during summer season.

Table 4.6. the frequency of respondents on honey harvesting seasons n=120

Description	Response of Respondent	Type of Agro-ecology						Total	
		High land		Mid land		Low land		n	%
		n	%	n	%	n	%		
Autumn(September, October, November)	Yes	37	92.5	39	97.5	40	100	116	96.7
	No	3	7.5	1	2.5	-	-	4	3.3

Winter(Decemb er, January, February)	Yes No	2 38	5 95	4 36	10 90	9 31	22.5 77.5	15 85	12.5 87.5
Spring(March, April, may)	Yes No	19 21	47.5 52.5	31 9	77.5 22.5	35 5	87.5 12.5	85 15	70.8 29.2
Summer(Jun ,July, August)	Yes No	- 40	 100	3 37	7.5 92.5	8 32	20 80	11 109	9.2 90.8

n=total number of respondents

4.1.3.5. Average honey Products harvested annually per hive

As a survey result, the respondents indicated that the minimum value of honey they collect from traditional hive is about 2.5 kg,and the maximum value of honey collected from traditional hive is about 10.5 kg, while the minimum value of honey they collect from transitional hive is about 5.5 kg, and the maximum value of honey they collect from transitional hive is about 14.5 kg. then the minimum value of honey they collect from modern hive is about 8.5 kg ,and the maximum value of honey collected from modern hive is about 19.5 kg.

The average annual of honey harvested from traditional, transitional and modern hive were 6.5 kg, 10 kg and 14 kg per hive respectively (Table 8).This result was similar with the result reported by Workneh et al (2008) states that the average amount of honey harvested per traditional, transitional and modern hive in West, South West and North Shoa zones to be 6.2 kg, 9.81kg and 13.26kg respectively.

Table 4.7. Averege honey harvested annual per traditional, transitional and modern hive.

Type of hive	Description		
	Minimum value Kg/hive/year	Maximum value Kg/hive/year	Average Kg/hive/year
Traditional	2.5	10.5	6.5
Transitional	5.5	14.5	10
Modern	8.5	19.5	14

4.1.3.6. Honey bee colony inspection

In the study district,about 54.2 % of the respondents replied that they undertake inspection of their bee colonies externally,13.3% of the respondent replied that they undertake inspection of their bee colonies internally,and 32.5% of the respondent replied that they undertake inspection of bee colonies internally and externally (Table 10).

However, the study described that internal hive inspection was limited to beehive placed at hanged up on long tree.Moreover, the beekeepers in the study area many frequently inspect their honey bee colonies external. Different researcher (Kerealem, 2005 ,and Chala, 2010) reported that farmers in Ethiopia low commonly practice internal hive inspection due to the difficulty of the traditional hives for internal inspection i.e. Fixed combs attached to the body of traditional beehive.

Table 4.8. Bee hive inspection system in study area n=120

Description	Frequency	%
External inspection	65	54.2
Internal inspection	16	13.3
Both External and internal inspection	39	32.5
Not at all	-	-

4.1.4. Marketing of honey, Storage container, and honey price in the study area

4.1.4.1. Honey marketing

In the study area, the survey results indicated that the main actors in the honey market chain in the district are producers/farmers(Table 4.9).Producer are mainly smaller holder farmers who supply their honey to Tej house, to wholesalers and direct for consumers. In this, about 9.2% (10 % in high land, 10% in mid land, and 7.5% in low land) of beekeepers used their honey for home consumption, while 5.8%(5% in high land, 7.5% in mid land ,and 5% in low land) sell to Tej house, and 85 %(85 % in high land,82.5% in mid land,87.5 % in low land) honey to wholesalers. This result is in agreement with the result of Etenesh Mekonnen, (2016) who reported 81.5% of beekeepers supply their honey for marketing; 50.6% sell to tej house, 31.9% to customers in Ada Berga District, West Showa Zone, Oromia, and agree with the study of Segni Shimelis, (2017) 85.6% sell their honey at market found in nearby town followed by farm

gate (10%) and Tej house (4%) in Ejere District, West Showa Zone, Oromia National Regional State, Ethiopia.

Table 4.9. Market trends of honey products in the district n=120

method of selling honey in the study area	Type of agro-ecology						Total	
	High land (%)	n	Mid land	n (%)	Low land	n (%)	n	%
To Tej house	2	5	3	7.5	2	5	7	5.8
Wholesalers	34	85	33	82.5	35	87.5	102	85
For home Consumption	4	10	4	10	3	7.5	11	9.2
Total	40	100	40	100	40	100	120	100

4.1.4.2. Marketing honey price in the study area

The color of honey in the study area is yellow, red and somewhat white. The mean price of yellow honey pure texture is 312.5 %, and crude texture are 237.5 % from 2012 up to 2015 production years. The mean price of white honey pure texture, and crude texture form are 242.5 % and 192.5 % respectively from 2012 up to 2015, while the mean price of red honey texture of pure is 205 %, and crude texture form are 165 % from 2012 EC up to 2015 EC

In general, the mean price of yellow honey type was higher than the white and red honey, on the other hand the mean price for white higher than red honey as a serve results indicts in (Table 12).This shows that consumers are highly attracted by the color of honey than any other characteristics. Even though the physicochemical properties of honey is important in determining the quality grade, at the moment, traditional quality indicators (color, taste, purity and storage container) are used for grading and pricing honey in study area.Emana and Begna(2006)improving honey production and marketing in sekota district.

Table 4.10.The average price (in Ethiopia Birr/kg) of different honey types over four years in the study area

Type of honey	Texture	Production year				Mean price (birr)
		2012 EC	2013 EC	2014 EC	2015 EC	
Yellow	Pure	150	250	350	500	312.5
	Crude	100	180	270	400	237.5
White	Pure	120	200	250	400	242.5
	Crude	70	150	200	350	192.5
Red	Pure	100	150	220	350	205
	Crude	60	120	180	300	165

Source: Gohatsion District Agricultural office 2016 EC

4.1.5. Major Constraints of Honey Production in the study Districts

4.1.5.1 Honey bee Pests and Predators

Among all constraints of beekeeping, natural bee enemies were known to cause great damage to honey bee colony life and products.In the study area major pests and predators considered as challenges were ants, spider, termite, honey badger, wax moth, bee eating birds, hive beetles and bee lice. Similar results were also reported by Kerealem (2005). From survey result as a percent observed that 32.5% (32.3% in high land,37.5% in mid land, and 27.5% in low land) ants in the first level, while 25.8%(30% in high land,22.5% in mid land,25% in low land) spider in second level, and 13.4%(12.5% in high land ,12.5% in mid land,15% in low land) termite in thread level, also 10%(7.5% in high land,10% in mid land, and 12.5% in low land) honey badger in forth level, and 5.7%(5% in high land,7.5 % in mid land, and 5% in low land) wax moth in fifth level, while 5% (7.5% in high land,2.5% in mid land, and 5% in low land) bee eating birds in six level, also 4.2%(2.5% in high land,2.5% in mid land, and 7.5% in low land) hive beetles in seven level, and 3.4 %(2.5% in high land,5% in mid land, and 2.5% in low land) bee lice in eight level,respectively ranked by respondents in and around their apiary site.disagree with the study of Tesfaye Bekele (2017) who reported 50.3% honey badger the first enemy in and around their apiary sites in Bale zone, South Eastern Ethiopia.

Table 4.11.Major honey bee pest and predators in the study area n=120

Pest and predators	Type of Agro- ecology						Total		Rank
	High land		Mid land		Low land		n	%	
	n	%	n	%	n	%			
Ants	13	32.3	15	37.5	11	27.5	39	32.5	1
Spider	12	30	9	22.5	10	25	31	25.8	2
Termites	5	12.5	5	12.5	6	15	16	13.4	3
Honey badger	3	7.5	4	10	5	12.5	12	10	4
Wax moth	2	5	3	7.5	2	5	7	5.7	5
Bee eating birds	3	7.5	1	2.5	2	5	6	5	6
Hive beetles	1	2.5	1	2.5	3	7.5	5	4.2	7
Bee lice	1	2.5	2	5	1	2.5	4	3.4	8

4.1.5.2. Miss use of pesticides and herbicides

In this survey result, respondents response 4.2% (5% in high land,2.5% in mid land,5% in low land) use only herbicide chemicals used to control undesirable plants, whereas 3.3% (2.5 % in high land,2.5% in mid land, and 5% in low land) use only pesticides chemical to control pest,about 92.5% (92.5% in high land,95% in mid land, and 90% in low land) use both herbicides and pesticides chemicals for agriculture activity (Table 15). In line with the study of Tesfaye Bekele et al (2020) who reported 97.1% were pesticides and herbicides users in crop production and only 2.9% were none pesticides and herbicides users in some selected districts of Bale Zone, South Eastern Ethiopia.

Table 4.12.The use of agrochemicals in the study area n=120

Descriptions	Respondents response	High land		Mid land		Low land		Total	
		n	%	n	%	n	%	n	%
What types of agrochemicals did use?		n	%	n	%	n	%	n	%
	Herbicides only	2	5	1	2.5	2	5	5	4.2
	Pesticides only	1	2.5	1	2.5	2	5	4	3.3
	Both	37	92.5	38	95	36	90	111	92.5

4.1.6. Absconding and Swarming bee colony

4.1.6.1.Occurrence of Absconding

According to the results of this survey, the main reason for absconding of honey bee in the study districts were indicated in (Table 16).about this 44.1% (42.5 % in high land,47.5% in mid land, and 42.5% in low land) of honey bee absconding by pest and predator,20% (20% in high land,17.5% in mid land, and 22.5% in low land) absconding by agrochemicals,21.7% (22.5% in high land,22.5% in mid land, and 20% in low land) absconding by shortage of beeforage,4.2% (5 % in high land,2.5% in mid land, and 5% in low land) absconding by low availability of water, 3.3% (2.5 % in high land,5% in mid land, and 2.5% in low land) absconding by low level of technology,4.2% (2.5 % in high land,2.5% in mid land, and 5% in low land) absconding by destructive ways of honey harvesting, and 2.5% (2.5 % in high land,2.5% in mid land, and 2.5% in low land) absconding by excessive rain (Table 16).The value of the result higher than Etenesh Mekonen (2016) about 0.6% in the high land,5% in the mid land ,and 1.9 % in the low lad honey bee absconding by pest and predator. This survey result is in agreement with Getachew Abreham (2018) who reported similar reasons for

colony absconding in Gesha district South west Ethiopia, and usually absconding occurs as a result of shortage of food or reduction in the honey flow, disturbance of the colony, either by pests, predators, bad management by the beekeepers, destructive ways of honey harvest, the beekeepers might use unsuitable hives (too big, too humid, bad smell) unsuitable places (too much shade, no shelter from rain or excessive heat, and exposed all day to the sun).

Table 4.13.Absconding and reasons in the study districts n=120

What are The reasons For bees Absconding?		Type of agro-ecology			Total percent of respondent who experience constraints
		High land	Mid land	Low land	
		n %	n %	n %	n %
	Honey bee pest and predators	17 42.5	19 47.5	17 42.5	53 44.1
	Agrochemicals	8 20	7 17.5	9 22.5	24 20
	Shortage of bee forage	9 22.5	9 22.5	8 20	26 21.7
	Low availability of water	2 5	1 2.5	2 5	5 4.2
	Low level of technology	1 2.5	2 5	1 2.5	4 3.3
	Destructive ways of honey harvesting	2 5	1 2.5	2 5	5 4.2
	Excessive rain	1 2.5	1 2.5	1 2.5	3 2.5
Total		40 100	40 100	40 100	120 100

4.1.6.2 Swarming of bee

According to survey result in study area, about 79.2%(90% in high land, 80% in mid land, 67.5% in low land)in autumn season (September,October, November),and 12.5%(7.5% in high land,12.5% in mid land, and 17.5% in low land)in winter season (December January, February) swarming of bee occurred, respectively, while 6.7%(2.5% in high land,7.5% in mid land,10% in low land)in spring season(March,Apiril ,May),and 1.6%(5% only in low land) in summer season (Jun,Julay.August) swarming colony occur (Table 4.14).But occasional swarms can happen throughout the producing month. In caching swarming of bee colony at study area the respondent to collect the queen bee from tall tree by experienced beekeepers often remove clusters simply by brushing or shaking the tree branch contain bees gently in to a cardboard box and carrying them away, and place the box in the shade until night fall, Then seal and remove it after dark(figure 12).This result agrees with report of Tessega (2009)who recorded experience in caching swarm for beekeepers Burie District of Amhara Region.

Table 4.14. Frequency of reproductive swarming occurs in the study area n=120

Season of occurrence	Type of agro-ecology						Total	
	High land		Mid land		Low land			
	n	%	n	%	n	%	n	%
(September October,November)	36	90	32	80	27	67.5	95	79.2
(December January, February)	3	7.5	5	12.5	7	17.5	15	12.5
(March,Apiril May)	1	2.5	3	7.5	4	10	8	6.7
(Jun,Julay.August)	-	-			2	5	1	1.6

4.1.7 Major honeybee floras and their flowering calendar

At the survey result showed that were many kinds of flowering plants including trees, herbs, and shrubs with their scientific name, local names and flowering seasons (Table 4.15).

In total of 16 pollen and /or nectar source plants species were identified during the survey work (Table 4.15),These bee flora included:*Biden spp,Ruta chalepensis,Curcurbita pepo,Cymbopogen ciratus, Ocimum basilicum, Lepidium sativum, Guitozia abyssinica,Cicer artietinum,Pisum sativum,Vacia faba,Zeamays,Ocimumlamifolium,Lycopersicon esculentum,Vernonia amygdalina,Ficus spp,Eucalyptus golbulus* (Table 4.15).Agree with Gidey and Teferi (2010) indicated that trees ,herbs, and cultivated crops are the main honey bee forage in Northern Ethiopia.

Different bee forages bear flower at different months and visited by honey bees for different number of days. Most important honeybee floras of the district area were between Julys up to January, and found at agro-ecology level of high land, Mid land and low land respectively. Some of plant spices like teff, bean, check pea, filed pea and maize were common to the top cereal crops grown by the sample farmers. The dominance of the cereals in the area may be related to the food or dietary habits of the communities as well as the local climates, which favored the types of crop production. Vegetables and various fruits were also grown for cash generation as well as for home consumption**.**

The foraging habits of different bee species vary, with each type of bee visiting flowers during different months and for varying durations. The most important nectar sources for honey bees in the region were observed between the months of July and January, occurring at high, mid, and low elevations respectively. Some of the common crop plants grown by the sampled farmers included teff, beans, chickpeas, field peas, and maize -all of which are major cereal crops in the area. In addition to the staple cereals, the farmers also grew various vegetables and fruits, both for income generation and household consumption.

Table 4.15. List of some major honeybee floral types,agroecology level, and flowering calendar in The study area

Plant spp (Floral type)	Amharic Name	Scientific name	Agro ecology			Flowering Calendar
			High Land	Mid Land	Low land	
Herb	Adeyabeba	Biden spp	√	√	√	august __October
Herb	Teenadem	Ruta chalepensis		√	√	July_____December

Herb	Dubba	Curcurbita pepo	√	√	√	Sember__December
Herb	Tejsar	Cymbopogen ciratus	√	√	√	July_____December
Herb	Besobilla	Ocimum basilicum	√	√	√	July_____December
Herb	Feto	Lepidium sativum	√	√	√	October__December
Crop	Nuge	Guitozia abyssinica	√	√	√	October – December
Crop	Shembera	Cicer artietinum		√		November_December
Crop	Ater	Pisum sativum		√	√	November– October
Crop	Bakela	Vacia faba		√	√	November – May
Crop	Bekolo	Zea mays	√	√	√	Sepr – Novembe
Crop	Damakesse	Ocimum lamifolium	√	√	√	Sept _Octobe
Crop	Timatim	Lycopersicon esculentum	√	√	√	year round
Tree	Girawa	Vernonia amygdalina	√	√	√	Year round
Tree	Shola	Ficus spp	√	√	√	January__may
Tree	Nech-Bahir zaf	Eucalyptus golbulus	√	√	√	February__may

4.1.8.Plants species toxic to bees

In this survey study, Out of the total number of respondents, 11% were experienced beekeepers who reported that they are aware of plants that are toxic or suspected to be toxic to honey bees within the study region.plant species identified by beekeepers as being harmful to honey bees were *Euphorbiaceae(Family name),Justica schimperianab, Nicotinia rustica, and Phytolacca dodecandra* as a scientific name (Table 19).Fortunately,there are relatively few such plants listed in the study areas more found in mid and low altitude. Experienced bee keepers explained that the bees become unconscious and show the act of intoxicated by rotating around the toxic plants.

Similarly,Nuru (2002) reported that some poisonous bee plants from Northern regions of Ethiopia, and pollen grains of nine poisonous species of bee plants from the families *Ranuculaceae*, *Solanaceae, Acanthacae, Euphorbiaceae* and *Phytolacaceae*. Kerealem (2005) also mentioned that *Gumero*, Yeferenj Digit (*Cassia siamea*), Bisan (*Croton macrostachyus*), Iret (*Aloe brahana*), Endod (*Phytolacca dodecandra*) and *Susbania spp* are suspected bee toxic plant in Amhara Region. However, for full evidence further research works are required to confirm if the plants are truly bee poisoning and which resources (nectar and/or pollen) is responsible to the act, before recommending eradication control.

Table 4.16.Plant species reported to be potentially toxic to bees in Gohatsion woreda

Plant spp(floral type)	Local name (Afaan oromo)	Scientific name	agro-ecology			Flowering calendar
			High Land	Mid land	Low land	
Tree	Abaaboo Diimaa	Euphorbiace (Family name)	√	√	√	Septemb—December
Herbs	Dhummugaa (Sensel in Amharic)	Justic schimperiana	√	√	√	Throughout a year
Herbs	Tam o	Nicotini rs ica	√	√	√	October—December
Herbs	Endod	Phytolacca dodecandra	√	√	√	Throughout a year

4.1.9. Supplemental Feeds of bees

During the survey period it was observed that majority of the respondents 82.5% did not practice supplemental feeding to bee colonies.However,17.5% of the respondents provide supplemental feed to their bees during dearth period (Table 4.17).To overcome the problem, supplementary feed was required for the honey bees. The most common locally available feed types used for colony supplement provided for prevented starvation were sugar syrup, honey, shiro (flour of peas and bean),maize/barleyflour,fafa(supplementary food for infants) by 24.2%,13.3%,26.7%, 31.7%,and 4.1% respectively when there was a need for emergency feed(table 20).Beekeepers may need to aid their bees in feeding especially when there was a limited supply of nectar. It is important to understand the different feeding requirements associated during dry season to sustain healthy colonies, and would be avoid the chances of the bees dying because of starvation.

Table 4.17 Different supplemental diets used to feed bees during dearth

Periods in Gohatsion district n=120

Description	Respondents Response	Total respondents From three type of Agro-ecology	Percentages

Practice feeding/ Not practice feeding	Practice feeding Not practice feeding	21 99	17.5% 82.5%
Feed types	Sugar syrup Honey Shiro(peas and bean flour Maize/barley flour Fafa(supplementary food For infants)	29 16 32 38 5	24.2% 13.3% 26.7% 31.7% 4.1%

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Based on the finding of this study, it can be concluded that beekeeping in the study area is dominated by men.

- The results of the study showed that the majority of the rural beekeepers engaged in traditional method, because it is easy to construct and relatively affordable.
- The study revealed that traditional, transitional and improved beehives were used by the beekeepers for honey production in the study area
- The inspection frequency of colonized hive is mostly accidental or rare in the study area.
- The finding revealed the major limiting factors in honey production in the study area were honey bee pest and predators, traditional technology, lack of proper management for beehive, agrochemicals, shortage of bee food, and low availability of water.
- Honey produced in the area was harvested in traditional way and its low quality
- Beekeepers refer to suitability of trees branches to hang hives rather than considering flora source for honeybees.
- The current study revealed that traditional beehives give less honey production than transitional and modern beehives.
- The finding of the study also shows that pests like ants, spiders, termites, honey badger, wax moth, and Bee lice were limit honey production activities by consuming the honey and killing the bee colonies.

5.2 Recommendations

Based on the findings of this study, the following recommendations were made:

- Gohatsion district Livestock Fishery Development office should give enough attention by giving sufficient training and continuous assistance for the beekeepers
- Concerned bodies should encourage women participation in honey production through provision of training.
- The local government administration and agricultural department should establish strong market connections and develop an effective system for disseminating market information about bee products. This would be crucial in making beekeeping a more appealing and viable livelihood option for farmers.
- Awareness creation for beekeepers in terms of hive management need to be practiced.
- The beekeepers would use the biological method instead of chemical that affect the bee around apiary site, cleaning hives area and planting bee forage.
- Developing indigenous knowledge in supporting by scientific method to control the limiting factors.
- Increasing production and quality of honey by improving management practices, placement of beehives and environmental conservation.
- Large scale and comprehensive research for further investigation on limiting factors the current status of apiculture that affect honey production highly recommended to set appropriate solution.

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7. Appendices

Appendix.1 questionnaire used to gather data

Dear respondents,

The purpose of this questionnaire is to collect data on Assessment of Honeybee production practice and factors that affecting Honey production in the Gohatsyon District of North Shewa Zone, Oromia Regional State, Ethiopia

This questionnaire is filled out by respondents selected randomly from the area. Since the quality and success of this study depends on the information you supply, you are kindly requested to provide your genuine response. Rite at the outset, I would like to assure you that by our response will be used only for research purposes and will be kept confidential.

Please provide appropriate response by circling on the letter that holds your answer, and write your opinion briefly for short answer question on the space provided for open ended questions.

There is no need to write your name

Tadesse ketema

Telephone:0913486236

I. Personal information of the respondents

a.Name of keble_____

1.Location of kebele A.Rural B.urban

2.sex A. Femal B.Male

3.Age A. 21__ 45 B. 46__60 C. >60

4.Marital status: A. Married B. single

5.Total family size A. 1—5 B. > 5 C. wife and husband only D. wife and child only

6. Education back ground: A. illiterate B. Can only read and write C. Grade 1-8

D. Grade 9-12 E.TVET/College F. university

7. Working experience? A. 1-3 B. 4_7 C. 8—12 D. 13—18 E. >18

8. What sex group that involved in honey production at the study area?

A. Male B.Femal C. both

9. Does Gohatsion district have suitable conditions for honey production? A. yes B. no

10. Do your family involve in any-farm activities? A.yes B. no

11. In which hives your colonies do more likely affected by the diseases?

A. Traditional B. Transitional C. Modern

12. How many times do you train beekeeping at FTC? A. once a week B. once a month
C. twice a Month D.once in a year E.twice in a year F.no

13. What was the support of extension workers in honey production?
A. low B. High C. Medium D.no

14. What was your income from honey from ancient to now? A.Decrease B. increaseC. Constant

15. What was the optimum harvesting season? A. summer B. winter C. Spring
D. Autumn E. All

16. The effect of deforestation on beekeeping was? A.High B. low C. Medium D.no

17. Material support in honey production was from? A.NGOs B. Government
C.your own D. Extension worker

18. Do you visit and inspect your beehives and colonies? 1.yes 2.no

18.1.Frequency of inspection A. frequently B. sometimes C. rarely

18.2. If no inspecton, what is the reason?

19. Do your family involve in any-farm activities? A.yes B. no

If yes, what type of-farm activities you/your family involved?

20. Do you harvest enough products from traditional hive? A. yes B.no
If not, why

21. Did your colonies abscond? A. yes B.no
If yes, what were the reasons for bees absconding hive?

22.when did you start beekeeping ?_____years

23. How did you start beekeeping?

24. List the honeybee equipment in the area?

25. List the limiting factors affect honey production in your environment?

26. Which limiting factor highly affects honey production?

27. Do you use agrochemical/chemicals in your locality?

28. Why agrochemicals/chemicals do you apply?

29. What type of agrochemicals/chemicals were farmers using?

30.Dose the government give you support to overcome some of the limiting factors of honey
Production?

31. If your answer to question 31 above was yes, list the support you got from the government.

32. Amount of honey you harvested per year in kg?

a. From one traditional hive In kg?

b. from one transitional hive in kg?

c from one modern hive in kg?

33. In your keble honey harvested was mostly used for what ?

34. What is the optimum harvesting season?

35. What type of hive do you use?

36. Where do you keep your hives?

37. Where do you sell your honey?

38. What methods do you use to control/prevent/swarming?

39. List you provide supplementary feed to your honeybee during feed shortage period?

Appendix-2 Interview questions for apiculturist

1. Do you have potential of honey production?

2. Does your keble have involved in honey production?

3. Which members of the society involved in honey production?

4. What types of hive does farmer/beekeeper use in your keble? Traditional or Modern?

5. Which hive type more important in honey production?

6. Do you harvest enough products from traditional hive? If not, why?

7. Do you have had any training from government or NGO or both?

8. Do you use any chemicals like herbicide pesticide on your other fields farming?

9. Is there a plant, which affects bee and their product in your districts?

10. Who are your customers?

11. Does beekeeping profitable to the area? How?

12. What are major constraints of honey market?

13. What are recommended solutions for constraints of honey market?

Appendix-3 Observation plates in the study areas

Appendix 3a.honey marketing in the study areas

Appendix 3b. Honey bee comb affected by honey badger and Ants

Appendix 3c.different hive types at open space in the study areas