HONEY PRODUCTION AND MARKETING SYSTEM IN THREE SELECTED DISTRICTES OF KEMBATA TEMBARO ZONE, SOUTERN ETHIOPIA

M.Sc. Thesis

BY

Melese Meno Abose

April, 2015

Jimma University

HONEY PRODUCTION AND MARKETING SYSTEM IN THE THREE SEECTED DISTRICTES OF KEMBATA TEMBARO ZONE SOUTHERN, ETHIOPIA

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Melese Meno Abose

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APPROVAL SHEET

SCHOOL OF GRADUATE STUDIES
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As thesis research advisor, we here by certify that we have read and evaluated the thesis prepared, under our guidance, by **Melese Meno** entitled "**Honey Production and Marketing System in the three selected districts of Kembata Tembaro Zone Southern, Ethiopia''** we recommend that it be submitted as fulfilling thesis requirement.

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As members of Board of Examiners of the M.Sc. thesis open defense examination, we certify that we have read, evaluated the thesis prepared by Melese Meno**,** and examined the candidate. We recommended that the thesis could be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Agriculture (Animal Production).

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DEDICATION

To my mother, for her pure and unconditional love

STATEMENT OF AUTHOR

I declare that the thesis here by submitted for the M.Sc. Degree at the Jimma University, College of Agriculture and Veterinary Medicine is my own work and has not been previously submitted by me or others at another University or institution for any Degree. I concede copyright of the thesis in favour of the Jimma University, Collage of Agriculture and Veterinary Medicine.

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BIOGRAPHICAL SKETCH

The author was born in Wonji Showa town, Oromia Regional State in 1979 G.C. He started his elementary school education at Tigileledget in 1988 G.C and completed his elementary school in 1995 and he started his secondary school at Wonji Showa Compressive High School in 1996.And completed in 2000. Then, he joined Debub University, Awassa College of Agriculture in 2001, and graduated with B.Sc. Degree in Animal and Range Sciences in 2005. After graduation, he joined in the government office in Angecha Agricultural and Rural Development Office and served until he joined Jimma University, School of Graduate Studies for the Degree of Master of Science in Animal Production in 2012.

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LIST OF ABREVIATIONS

AN0VA	Analysis of Variance
CSA	Central Statistical Agent
DA	Development Agent
EEPD	Ethiopian Export Promotion Department
ETB	Ethiopian Birr
FAO	Food and Agricultural Organization
GDS	Global Development Solution
HBRC	Holeta Bee Research Centre
Kg	Kilo grams
PRA	Participatory Rural Appraisal
SC-UK	Save the Children UK
SNNPS	Southern ,Nation and Nationalities and People
SOS	Save Our Soul international ,U.K
SPSS	Software Packages for Social Sciences

HONEY PRODUCTION AND MARKAING SYSTM IN THREE SELECTED DISTRICS OF KEMBATA TEMBRO ZONE, SOUTHERN ETHIOPIA

ABSTRACT

A study on honey production and marketing systems was conducted in three selected districts of Kembata Tembaro Zone of Southern Ethiopia. The specific objectives of the study were to assess honey production and marketing system opportunities and constraints in the study area. Producer's interview was the sources of the primary data while, secondary data was taken from Kembata Tembaro Zone. The study districts were classified based on agro ecology as highland (2600-3100 m.a.s.l.), mid- land (1501 to 2500 m.a.s.l.) and lowland (below 1500 m.a.s.l.). From each selected agro ecology, two PA's were purposively selected based on potentials for honeybee colonies and honey production. A total of 180 households were randomly selected using systematic random sampling method from the six PA's. Questionnaire based survey as well as PRA techniques were employed to collect both quantitative and qualitative data. Beekeeping is dominantly practiced by male households in highland (98.3%) and midland (95%) and lowland (93.3%) of the study area. In the study area, three types of honeybee production practices were identified, namely: traditional, transitional and movable frame hives. About 76% of bee hives owned by the beekeepers was traditional hives, while the remaining 19.4% and 4.6% of hives were movable frame and top bar bee hives, respectively. The main purposes of keeping honeybees were for both income generation and home consumption. The major sources of the foundation colony were catching swarm (76.2%) then followed by (21.1%) gift from parent and buying (2.2%). The overall mean honeybee colony holding per HH in the study areas was (7.91 ±7.27). The average colony holding (10.88± 8.34) of lowland households was significantly ($p<0.001$) higher than midland (8.52 ± 7.83) and highland (4.32 ±4.32) areas. According to the 55% of the respondents, honey harvesting is done twice, (43.9%) once and 1.1% three times per year. The lowland respondents had the highest mean honey production of 115.8kg / year / HH than midland (71.85kg) and highland (14.10kg)/year/HH). The average productivity of traditional, transitional and movable frame bee hives in 2013 was 4.28±2.12, 10.22 ± 4.75 and 17.16 ±5.89 kg / year, respectively. About 35.6% of respondents did not control swarming while, some of them (64.4%) control swarming by cutting and removing some part of brood combs. The overall average annual gross income of the studied respondents from beekeeping was Birr 2,053.38 Birr/HH /year and it was significantly different ($p<0.001$) among the three districts. The overall average price of crude honey and table honey in the study area was 29.5 Birr/kg and 51.2Birr/kg respectively. The major constraints to exploit the untapped potential of beekeeping activity in the study areas were incidence of pest, shortage of beekeeping equipment, shortage of bee forage, high costs of modern hives, absconding, poor extension service, pesticide and herbicide, inadequate access to training and excessive rain fall. Therefore, the results suggest that beekeeping development efforts should be focused on Practical oriented training on improved beekeeping practices should be given for the farmers and development agents to alleviate the major constraints. There is a need to enhance extension services in the area and also credit provision need to be facilitated to supply improved beehives and accessory equipment.

Key words: *Honeybee; Honey Production, Beehive, Marketing, Income*

1. INTRODUCTION

Beekeeping in Ethiopia is a long-standing agricultural practice. It has been exercised as a Sideline activity by many of the rural farming communities for its honey and beeswax Production that contributes to income generation (MoARD, 2010). It also provides job opportunity in the sector. The role it plays in enhancing food security, poverty reduction and food production through pollination of crops has become substantial in the recent years.

There is no well-documented evidence that indicates when and where beekeeping practice started in Ethiopia. According to Ayalew (1978), it had started in the country between 3500–3000 BC.From the rural community's point of view; beekeeping is an inherited tradition and an ideal occupation that contributes for improvement of livelihoods.

The country has a high potential for beekeeping as the climate is favourable for growing different vegetation and crops, which are a good source of nectar and pollen for honeybees. Due to suitable natural environment of the country more than one million households are estimated to keep bees using traditional, intermediate and modern hives (Gidey and Mekonen, 2010).

Ethiopia is believed to possess high potential in producing the honey. Ethiopia is currently ranked as the leading honey producer honey producer in Africa and one of the 10 largest honey-producing countries in the worldwide by producing 45,300 tons of honey in 2010 (FAOSTAT, 2012).

Many people are engaged in the production and trading of honey at different levels and selling of honey wines (local beverage Tej) which create employment opportunities for large number of citizens (Beyene and David, 2007).And more than 95% of the honey and beeswax produced in Ethiopia is obtained from traditional beekeeping the remaining 5 percent includes transitional and modern beekeeping. In the country, an average of 420 million Ethiopia Birr is obtained annually from the sale of honey (ECAEPA, 2006). Honey production of the country meets beverage requirements of the urban and rural population and also export of honey and beeswax contributes an average of 1.6 million USD to the annual

national export earnings (ECAEPA, 2006). It is also demanded for its nutritional and medicinal values.

Although Ethiopian has a huge beekeeping potential, the country did not realize the benefits of the subsector until recently. The share of the subsector in the GDP is not corresponding with the huge numbers of honeybee colonies and the country's potential for beekeeping (MoARD, 2007). The low productivity of apicultural sectors led to underutilization of hive products both domestically and in export earnings (Nuru, 2007). Consequently, the country in general and the beekeepers in particular are not benefitting from the huge potential that exists on the apiculture sub-sectors.

Therefore, the products obtained from this subsector are still low as compared to the potential of the country because of several factors such as lack of appropriate production technologies, Weak market and absence of value chain development largely resulted in much lower contribution of the honey subsector (Wilson, 2006; 2006). And also lack of beekeeping knowledge, shortage of trained manpower, pests and predators and inadequate research are the major constraints in Ethiopia (SOS-Sahel-Ethiopia, 2006).

In addition to, Investigation indicated that the number of the honeybee colonies of the country has been declining (CSA, 1995) and consequently the honey and beeswax production as well as export earnings fell down (Gezahegn, 2001b). This is attributed to drought, ever-expanding population pressure and associated vegetation changes and indiscriminate applications of chemicals.

In recent years, the contributions of beekeeping in poverty reduction, sustainable development and conservation of natural resources have been recognized and well emphasized by the government of Ethiopia and Non-Governmental Organizations (NGOs). As the country is endowed with varied ecological zones and different flora, there is a great potential for the country for working with communities by introducing simple and easily adaptable apiculture production systems that will lead to considerable gains in productivity beyond family consumption needs (MoARD, 2007).

Production system study is important to identify problems and come up with research proposals relevant to the constraints and to formulate appropriate development plan for an area (Edessa, 2002). Hence, characterization of production systems, Identification and prioritization of the available constraints and suggesting possible intervention areas are the first steps towards any development planning in any fields and also in the apicultural sub-sector. Moreover, farming system approaches to research and development work is recognized as one of the most appropriate method used to diagnosis and gaining knowledge of the technologies and describes factors affecting production at farm level (Amir and Knipscheer, 1989).

The study area, Kembata Tembaro Zone that is found in SNNPR is one of the zones in the country with high potential for beekeeping and honey production. The area is densely covered with various types of trees, shrubs and cultivated crops that provide sufficient forage for bees. So far in Kembata Tembaro Zone there is no compiled and reliable information on honey production and marketing system. The numbers of beekeepers, bee colonies, and amount of honey produced, type of beekeeping practice, and constraints were not known.

Therefore, this research was initiated with the following specific objectives:

1.1. General objective

-To study and characterize the honey production and marketing systems of the study areas

1.2. Specific objectives

-To assess honey production systems of the study areas

- To assess honey marketing systems of the areas

- To identify the potentials and constraints of honey production in the study areas

2. LITRATURE REVIEWS

2.1. Importance of Beekeeping in Ethiopia

Apiculture plays a significant role in the national economy of the country (Nuru, 2007). The majority of Ethiopians live in rural areas depending on agriculture as their source of livelihood and apiculture is one of an important agricultural activity in most rural areas. As beekeeping has low start-up cost and requires little land or labor, It is accessible to many rural communities and is promoted as a pro-poor income generation activity (MoARD, 2007) .Frequent droughts coupled with environmental degradation have threatened the livelihood of this rural community for several decades (MoARD, 2007).

However, regardless of other agricultural activities, bees survive in drought-threatened areas and supplement the vulnerable communities with nutritious food, honey, and a source of income. Therefore ranges of applications emerging from apiculture development are enormous and it is considered a major tool of combating food insecurity, while protecting the environment. Furthermore, the apiculture subsector is emerging as a strategic means of export diversification (GDS, 2009).

Beekeeping, in addition to its economic importance, has high social value in the country. The number of honeybee colonies and hives owned serves as a major wealth ranking in some societies (Nuru, 2007). Honey is highly regarded product and in widely used in different cultural, religious, spiritual ceremonies and traditional medication (Nuru, 2007).

Apiculture has also a great role in natural resource protection. Beekeeping is environmentally friendly activity and beekeepers are more aware about the importance of conservation of natural resource than any ordinary farmers (Nuru, 2007). Integrating natural resource conservation programs with income generating options like utilizing the forest resources, In the form of honey and beeswax, while maintaining the natural vegetation would be an appropriate approach.

Beekeeping has many advantages that help farmer beekeepers to improve their well-being. Its advantages comparing with other agricultural activities beekeeping has many relative advantages because of the following reasons (Adjare, 1990; Palaniswamy, 2004; Nuru, 2007).

1. Beekeeping does not compete for resources with other agricultural activities. Hence, it can be integrated with annual and perennial crop production, animal husbandry and natural resource conservation.

2. Since beekeeping is light work, it can be done by women, aged men and persons with disabilities. Moreover, since it is less labor intensive, it can be done as part time and side line activity..

3. Beekeeping assists to utilize resources like pollen and nectar which otherwise are wasted. Man cannot utilize these resources without bees.

4. Unlike cultivation of crops and animal husbandry, beekeeping does not disturb the ecological balances of an area. Instead, it is an environmentally friendly activity..

5. Beekeeping can be run with little or no land, because bees can forage in any place around their foraging distances and it is useful for intensification of land and also in areas where there are shortage of land.

6. Bee products like honey and beeswax are not perishable and can be transported and stored for longer periods and their price does not fluctuate very much over seasons.

2.2. Current status of Honey Production in Ethiopia

In Ethiopia, honey production has been practiced for centuries in rural communities and already appears in the ancient history of the country (Ayalew and Gezahegn, 1991). Beekeeping is an environmentally friendly and non-farm business activity that has immense contribution to the economies of the society and to a national economy as whole.

Ethiopia is the largest honey producer in Africa and 10th largest honey producer all over the world. In addition to this a considerable amount of beeswax is produced in the country. On a world level, Ethiopia is the fourth in bees wax production (Girma, 1998). The country, having the highest number of bee colonies and surplus honey sources of flora, is the leading producer of honey and beeswax in Africa. The total honey production of the country is estimated to be more than 45, 000 metric tons per year (FAO, 2010).

In addition, Ethiopia has perhaps the longest tradition of all African countries in marketing of bee products like honey and wax. Out of the total honey produced in the country only a small amount of this is marketed. Besides poor marketing conditions the main reason is that about 80% of the total Ethiopian honey production goes in to the local Tej-preparation, a honey wine, which consumed as national drink in large quantities (Hartmann,2004).

The exact number of people engaged in the honey subsector in Ethiopia is not well known. However, It is estimated that one million farm households are involved in beekeeping business using the traditional, Intermediate and movable frame bee hive. It could also be observed that a large number of people (intermediaries and traders) participate in honey collection and retailing (at village, district and zonal levels). Thousands of households are engaged in Tej-making in almost all urban areas, hundreds of processors are emerging and exporters are also flourishing (Beyenee and David, 2007).

There are 5, 013, 848 traditional, 34, 552 transitional and 100, 843 movable frame bee hives in Ethiopia (GDS, 2009). Ninety-three present of honey production comes from traditional hives. Oromia , Amahra , Southern National Nationalities and People (SNNP) , and Tigray are the major honey producing regions with production quantities of 15 , 492 tons , 10 , 834 tons , 5 , 847 tons and 3904.6 tons , respectively , (GDS , 2009) .

Although the annual production of both honey and bees wax in Ethiopia is large compared to other African countries, the system of production commonly exercised in the country is traditional Productivity of honeybees is very low and only an average of 8-15kg of honey could be cropped per hive per year . However, in areas where improved technology has been introduced, an average of 15-20 kg/hive/year has been recorded (Gidey* and Mekonen, 2010).

2.3. Honey production practices in Ethiopia

Ethiopia is endowed with adequate water resources and various honeybee floras, which create fertile ground for the development of beekeeping. Honey hunting and beekeeping have been practiced in the country for the exploitation of honey and beeswax. In place where wild colonies of bees are found, honey hunting is still a common practice in Ethiopia. Currently, beekeeping in the country is being exercised in different production systems

2.3.1. Traditional beekeeping system

Beekeeping in Ethiopia has an ancient history and an integral part of the life style of the farming communities (Mammo, 1976; Ayalew, 1990). They are made of cheap and locally available materials like clay, straw, bamboo, false banana leaves, animal dung, grasses, and wicker (Ayalew, 1990). Traditionally constructed fixed beehives are mostly cylindrical in shape (about 1-1.5 meter in length and 30-50 cm width) and single chamber fixed comb. Since the combs are made fixed on the roof of the hive body, the honey can be removed only from breaking or cutting out the honey combs.

Traditional beekeeping is practiced with many millions of fixed comb hives in all parts of the country. These fixed comb hives can yield a modest amount of honey. Also the proportion of crude beeswax produced is about 8-10 percent of the crude honey weight HBRC (1997). This harvest is achieved with minimal cost and labour, and it is a valuable to people marginal's living standards. Gezahegn (2001a) and EARO (2000) stated that under Ethiopian farmers ' management condition, the average amount of crude honey produced from traditional hive is estimated to be 5 kg/hive/years. On the other hand, based on the survey conducted in West Showa Zone (Edessa, 2002) the amount of honey harvested forms a traditional hive on average was reported to be 6.1 kg/hive/years.

2.3.2. Transitional Beekeeping System

It is a type of beekeeping intermediate between traditional and modern beekeeping methods. Generally, top-bar hive is a single story long box with slopping sidewalls inward toward the bottom (forming an angle of 115^0 the floor) and covered with bars of fixed width, 32 mm for east African honeybees (Nicola, 2002).

Adjare (1990) and IBRA (1997) suggested that for technical and economic reasons, most African countries are not yet in the position to use movable- frame hives, and for them top-bar hive represents a satisfactory compromise.Although movable frame hives are recommended for experienced beekeepers that want to optimize honey production, the Kenya top-bar (KTB) hive has been proved to be most suitable because of its low cost and the fact that the beekeepers or local carpenters can easily construct it.

Transitional beekeeping started in Ethiopia since 1976 and the types of hives used are: Kenya top-bar hive, Tanzania top-bar hive and Mud- block hives. Among these, KTB is widely known and commonly used in many parts of the country (HBRC, 1997). The advantages of KTB over fixed comb hive and movable frame hive is discussed by Segeren (1995), Nicola (2002) and SOS Sahel (2002).

Top-bar hive in an ideal condition can yield about 50 kg of honey per year, but under Ethiopian condition, the average amount of crude honey produced would be 7-8 kg/hive/year (Gezahegne,2001a). However, at zonal level (North Wello) it has been reported that production of 24-26 kilograms crude honey per hive per year (SOS, Sahel 1999), and about 8 percent as much beeswax per kilogram of honey is likely to be obtained.

2.3.3. Moveable frame beehive Beekeeping System

Modern or moveable frame beehive beekeeping methods aim to obtain the maximum honey crop, season after season, without harming bees (Nicola, 2002). Movable-frame hive consists of precisely made rectangular box hives (hive bodies) superimposed one above the other in a tier.

Practical movable- frame hive was invented in 1851 by Lorenzo Lorraine Langstroth in U.S.A.(Crane, 1976; Vivian, 1985). Later on different countries developed their own

movable frame hives (for instance Zander, Dadant) and Langstroth was the prototype of movable frame hives used today. In many countries Langstroth hive boxes have proved to be convenient for handling and management.

The numbers of boxes are varied seasonally from the population size of bees. In Ethiopia, about 5 types of movable frame hives were introduced since 1970 (HBRC, 1997) and the most commonly used are, Zander and Lang troth style hives. Based on the national estimate, the average yield of pure honey from movable frame hive is 15-20 kg/year, and the amount of beeswax produced is 1-2% of the honey yield Gezahegne (2001a). However, in potential areas, up to 50-60 kg harvest has been reported HBRC (1997). Movable frame hives allow colony management and use of a higher level of technology , with larger colonies , and can give higher yields and quality honey but are likely require high investment cost and trained man power .

2.4. Honey marketing in Ethiopia

Honey production is frequently promoted as a pro-poor income generation activity as it is accessible to many members of a rural community, has low start-up costs and requires little land or labour. According to *MoARD (2003*), about 10% of the honey produced in the country is consumed by beekeeping households. The remaining 90% is sold for income generation and of this amount, it is estimated that 70% is used for brewing Tej and the balance is consumed as table honey. Tej brewers exclusively use crude honey from traditional hives.Even though, the national honey production satisfies the local demand, and it is so crude that it could not compete in the international market. In the year 2004 the quantity of honey and beeswax exported amounted to 15.72 tones and 305 tones, respectively (MoARD, 2006). The total export earnings from honey and beeswax were ETB 481,266 and 8.366 million, respectively (MoARD, 2006). Although the annual production of both honey and wax is large compared to other African countries, the system of production commonly exercised is traditional.

Beekeepers, honey and beeswax collectors, retailers, Tej brewers, processors and exporters are identified to be the key actors in the value chain of the honey sub-sector (Beyene and David, 2007). These are Tej brewers channel, honey processing and exporting channel and beeswax channel. These channels are complex and interconnected that implies absence of organized marketing channels and lack of formal linkages among the actors. Beekeepers directly sells their honey to local honey collectors (dealer or cooperatives) at districts or zonal

levels, which directly deliver the honey to Tej brewery houses in their localities and/or transport it to big honey dealers (verandah) for breweries in Addis Ababa. Some beekeepers who are producing large quantities of honey also directly supply it to Tej houses in their areas.

2.5 Potentials and constraints in Beekeeping

Ethiopia has enormous untapped potential for promoting beekeeping; both for local use and for export purpose. However, like any other livestock sector, this subsector has been ceased by complicated constraints.

The prevailing production constraints in the beekeeping subsector of the country would vary depending on the agro ecology of the areas where the activities is carried out (Edessa, 2005). Variations of production constraints also extend in socio-economic conditions, cultural practices and climate (seasons of the year). According to HBRC (1997), Ayalew (2001) and Edessa (2002), the major constraints in the beekeeping subsector are the following: the unpleasant behaviors of bees (aggressiveness, swarming tendency, and absconding behaviors); lack of skilled manpower and training institutions; low level of technology used; high price of improved beekeeping technologies; drought and deforestation of natural vegetation; poor post-harvest management of beehive products and marketing constraints; indiscriminate application of agrochemicals; honeybee disease, pest and predators; poor extension services; absence of coordination between research, extension and farmers; absence of policy in apiculture; shortage of records and up-to-date information; and inadequate research institutions to address the problems. But all these problems may not be constraints to all parts of the country and may not be equally pressing to every place. So it requires characterizing the constraints in their respective places to take an appropriate development measure.

Beekeeping research is new in Ethiopia. Holeta Bee Research Center (HBRC) is the main mandated institution undertaking applied and adaptive apicultural research that would support development (Gezahegn, 1996). The beekeeping research so far conducted in the country although encouraging is not satisfactory because one center could not address all parts of the country. Most of the research work is still being carried out on-station with modern technology and management systems. However, the great majority of beekeeping production

is based on traditional production systems where the results of on-station research may not often be applicable to the local conditions.

According to (Wilson, 2006).weak market access, weak price incentive systems, and limited financial capacity of beekeepers are the major problems which largely reduce the potential contribution of the honey subsector so this leads to low productivity and poor quality of bee products.

To address these challenges, there is a national interest in linking small scale beekeepers with agricultural marketing chains. Contract farming arrangements provide farmers with access to a wide range of services that otherwise may be unattainable. Access to market, credit, and new technologies and risk reduction are some of the benefits for farmers from contract farming (Minot, 2007). Regarding to bee products marketing, private companies have emerged that are largely involved in collecting and processing table honey for local and export markets. This is a breakthrough in the development of the apicultural industries of the country.

3. MATERIALS AND METHODS

3.1. Description of the study areas

This study was conducted in Doyogena, Damboya and Tembaro Districts of Kembata Tembaro Zone of Southern Ethiopia. Kembata Tembaro Zone is one of the 13 administrative zones in SNNPR found in the South-Western part of Ethiopia. The zone covers a total area of 1523.6 sq. km. and topographically, it lies between elevations ranging from 501 to 3000 meters above sea level.

The zone is situated between latitude 7.10 –7.50E and 37.34-38.07N longitude. The zone has three agrological zones, in which the highland (*Dega*), mid-land (*Woina-dega*) and lowland *(Kolla)* accounts for 14.3%, 73.17% and 12.53%, respectively. The annual mean temperature and rain fall of the zone ranges from 12.6-27.5 ºC and 1001-1400 mm, respectively. In the zone, the apicultural resources are immense; particularly in Damboya and Tembaro districts the natural vegetation coverage is relatively high. It was estimated that more than 35,000 honey bee population existed in the zone. So that the study areas were potential for honey bee (ARDB, 2010).

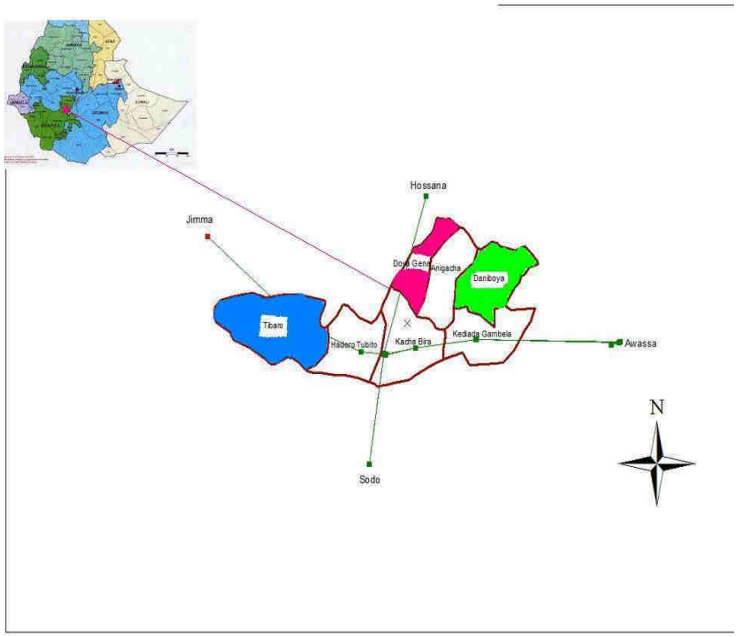

Figure 1 Location sites of the study areas

Sources: SNNPR Kembata Tembaro Zone Investments Expansion Main Process (2011)

The Zone has a total population of 768,300 of whom 376,467 are men and 391,833 women. While 97,797 (14.36%) are urban inhabitants (CSA, 2007). Durame town is the main city for the zone and located at a distance of about 350 km away from Addis Ababa, South-West of Ethiopia. Kembata Tembaro Zone has seven districts. Out of seven districts. Doyogena, Damboya and Tembaro are the three districts out of seven rural districts of the zone were selected for this study based on difference in agro ecology and beekeeping potentials .These were composed of highland, mid land and low land areas represented by Doyogena, Damboya and Tembaro Districts, respectively.

Based on the sources from zonal and each district's administrative offices; Doyogena district is located at a distance of 272 km, South West of Addis Ababa and 62 km from Durame the city of the zone. The district is located an altitude ranging from 2600-3100 meters above sea level and area coverage of 121.5 square kilometers. Mean annual rainfall of the district is 1600 to 2340 mm and the mean annual temperature is 11.5 – 24.5 ^{o}C.Doyogena is boarded on North by Lemu on South by Kachabira on West by Duna and on East Angacha districts.

Damboya located at an altitude ranging from 1501-2500 meters above sea level, 285 km South West of Addis Ababa and 30 kilometers from Durame. Mean annual rainfall and mean annual temperature of the district are 1200 to 1800 mm and 19 - 29^{o}C, respectively. The area coverage of the district is 151.83 square kilometers. Damboya is boarde on North by Angacha on South Kedida Gamella on East by Alaba special district and on West Kedida Gamella and Angacha districts.

Tembaro district is located about 360km South West Addis Ababa and about 60 km from Durame town. This district is predominantly low land and it is located an altitude of less than 1500 meters above sea level. Mean annual rainfall of the district is 900 to 1100 mm; whereas the mean annual temperature is 27 - 38^{o}C. The area coverage of the district's 279.18 square kilometers. Tembaro district is boarded on North by Sorro and Duna districts on South Wolayta and Dawero Zones on East by Hadero Tunto district and on West Jimma Zone.

3.2. Sampling Techniques and Sample Size

Based on the information obtained from secondary data sources, the district in the zone were stratified according to their agro ecological variations (lowland, medium land and highland).

From each agro-ecology, one district was selected purposively based on honeybee colonies and honey production (i.e. Doyogena from highland, Damboya from midland and Tembaro from lowland). Subsequently, two PAs were selected purposively from each district based on their honeybee colonies and honey production. Also, based on their beekeeping experiences, 30 beekeepers were selected using systematic random sampling method. From each peasant association making a total of 180 respondents from the three selected districts of the Zone.

3.3. Data Sources and Methods of Data collection

Both primary and secondary data were used to achieve the objectives of the study. Secondary data are were obtained from reports of each district Agricultural Development Office, Zonal Agricultural Department Office, Regional Bureau, NGOs and other published and unpublished materials prepared by different governmental and NGOs.

A full understanding in identification of major honeybee forage and floral cycle preparation were achieved by different methods. These were interviewing, personal observation, key informants and focus group discussion. To collect information regarding bee forage plants and related parameters like identification of common bee flora with their flowering time. And the scientific names were determined using reference books of Fichtl and Admassu (1994).

Similarly, in order to get the overall picture of honey producers, traders, and consumers of the honey marketing chain in the study area, the study used both primary and secondary data. The primary data were collected using two types of questionnaires, one for farmers (honey producers) and the other for honey traders.

In order to collect primary data, the Participatory Rural Appraisal (PRA) specifically Focus Group discussion (FGD) was used to undertake informal discussion with groups composed of key informants like; development agents, Expert in Rural Development of the respective districts, Elders, Women delegates and bee hive owners. Based on the information generated through PRA, the questionnaire and record sheets was developed for the formal interview/main survey. Then, the primary data was collected from sample respondents through the semi-structured questionnaire. Pre-testing of the questionnaire and record sheets was made as a pilot survey, and on the basis of information obtained during pre-testing,

modification was made on the questionnaire. Single-visit-multiple-subject formal survey method was employed to collect data on various aspects of beekeeping production and marketing systems. The enumerators were recruited from each selected study areas and these all were made acquainted with the questions, trained on methods of data collection and interviewing techniques.

3.4. Data collected

The study requires wide ranges of information with reference to beekeeping, honey production and marketing systems. Both qualitative and quantitative data were generated using conventional survey method, which include the following major data groups:

Household socio-economic characteristics: sex, age, family size, education level and economic variables: land holding size and crop production

Honey production and marketing systems: the present number of hives owned, type of hives used, the present number of hives occupied by honeybee colonies, beekeeping equipment's used, major honeybee flora, honey flow and dearth period, amount of honey and crude beeswax harvested, cost of production of honey and crude beeswax, honey and bee colony marketing situation and market prices.

Farmers' indigenous knowledge and practices: materials used to make beehives, place of keeping hives (site), hive inspection, methods of swarm control, swarm catching experiences, harvesting time and methods, honey storage facilities and post-harvest management of honey, mechanisms to control and treat honeybee diseases, predators, pests and etc.

Potential, constraints and opportunities of beekeeping in the area: potential honeybee plants and flowering time, poisonous plants, water resources availability, honeybee pests and predators, insecticides and other chemicals application, availability of credit and extension services.

3.5. Data Management and Statistical Analysis/Data analysis

Data (both qualitative and quantitative) were cleaned and entered into Microsoft office Excel sheet every day after administering questionnaire to prevent loss of data. All the surveyed

data were analyzed using statistical packages for social science (SPSS) version 16 (SPSS, 2007). Statistical variations for categorical data were tested by means of cross tabs, with significant differences at P< 0.05; while the descriptive statistics for the numerical data was subjected to one way analysis of variance (one-way ANOVA) using the general linear model procedure of SPSS. Mean comparisons was carried out using Duncan's multiple range tests.

For parameters required ranking, indices were calculated to provide ranking of major honey bee production constraint were calculated with the use of index methods. The indices were calculated as follows;

Index= Sum of (3 x number of household ranked first + 2 x number of household ranked second + 1 x number of household ranked third) given for an individual reason, criteria or preference divided by the sum of (3 x number of household ranked first + 2 x number of household ranked second + 1 x number of household ranked third) for overall reasons, criteria or preferences.

4. RESULTS AND DISCUSSIONS

4.1 Socio-Economic Characteristics of the households

According to the result of the study, from the total sampled household (N=180), 95.6 % of the beekeeping participants were headed by male (Table 1). Whereas, the rest (4.4 %) were female headed beekeepers (Table 1). This result in the current study is in agreement with the study conducted in Silti district, SNNPR (Alemayu, 2011) who reported (96.25%) of the beekeepers as male headed and (3.75%) as female headed households. .This is in line with similar study by Adebabay (2008), Tewodros (2010) in agreement with very limited number of female participation in beekeeping. Similarly, Hartmann (2004) reported as traditionally beekeeping is mainly men's job in Ethiopia. Sex of the household head were not significantly (P> 0.05) different among the three districts.

The age of the household head ranged from 22 to 74 years with overall average of 45.68 years old (Tables 1) and it was non-significantly different (P>0.05) among the three districts. As the results showed about 68.9% of the age distributions of household heads were in the active and productive age range i.e., 21 to 50 years.

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In Ethiopia, all age groups who are above ten years old in the rural areas are involved in agricultural activities (CSA, 2008). This proves that beekeeping is an important economic

activity that can be performed by all age groups, i.e., by younger and old people and it's important to increased availability of able-bodied labour for production and ease of adoption of apiculture related innovations. The present result was higher than the mean age of 40.7 years obtained in Gomma districts of Oromia regional states (Challa, 2010).

As the results showed that about 27.2 % of the respondents had no formal education at all, while majority (72.9%) of them can read and write (figure 2). With literacy rate of 72.9%, the person in the study area has a better educational entitlement which is more than the national average, i.e., 35.5% (Ethiopian Media, 2010).

The present literacy level in the study areas was higher than the report of Adebabay *et al.* (2008) and Tewodros (2010) who reported literate rate of more than 60% and 62.5% of the sampled respondents of Amahra Region and Sekota district, respectively. Thus, the result of this study indicates that most respondents of the study area can easily adopt apiculture extension services, technologies and be able to access relevant information.

As shown in (Table 1), the overall mean family size was 7.13 per household, and it was significantly different ($p<0.01$) among the three districts, being the highest in lowland 8.03 followed by midland 6.90 and highland 6.53 (Table 1). This result is higher than the study conducted in Gomma districts, Oromia region (Challa, 2010) who reported an average family size of 5.6 per household. This indicates that the respondent's large household could be important to honey production. Because family constitutes the bulk of labour supply to holding large bee colony for beekeepers and also it could be important contribution to increase the income obtain from beekeeping activity.

The mean land holding size in the study area was 0.7(0.03) ha/household (Table. 1) and this is lower than regional average of 0.89 ha per household (Ethiopian Economic Policy Research Institute 2001) and the national average of 1.18 ha given in the Agricultural Sample Survey (CSA 2007/2008). The average land holding in lowland 0.94ha/hh and it is significantly higher than ($P<0.05$) that of highland (0.04ha/hh) and midland (0.76ha/hh) area.

With regard to beekeeping experience out of the total sample only 10% of respondents had 5 to 8 years, 26.7% had 9 to15 years, 30.6 % had 16 to 20 years and 32.8% had is greater than 20 years of beekeeping experience (Table 1). The mean average of beekeeping experience in

the study area was 17.64 years old. There was significant deference ($p<0.05$) among the three districts, being the highest in midland (23 years) then followed by lowland (18.8 years) and highland (11.08 years), respectively. This result is in agreement with the study conducted in Silti Districts, SNNPR which reported that 18.54 years of experience (Alemayu, 2011) and higher than the result found in Gomma districts, with average experience of beekeeping per household 5.66 years (Challa 2010)). Hence, it was indicated that farmers with more experience in beekeeping would adopt the technology more and well experienced on bee keeping in the study areas.

Table 1 Socio economic characteristic of the house hold in the study area

Factors	Agro ecology,%			Total	p
	Highland N %	Midland N %	Lowland N %	N %	
Sex of HHs					
Male	59(98.3)	56(93.3)	57(95)	172(95.6)	ns
Female	1(1.7)	4(6.7)	3(5)	8(4.4)	ns
Total	**100**	**100**	**100**	**100**	
Age (Mean +SE)	45.95(1.13)	46.57(1.15)	46.68(1.13)	46.68(0.69)	ns
Age category					
21-30 years	4(6.7)	4 (6.7)	5(8.3)	13(7.2)	
31-40 years	11(18.3)	8(13.3)	20(33.3)	39(21.7)	
41-50 years	20(33.3)	34(56.7)	18 (30)	72(40)	
51-60 years	6(10)	4(6.7)	10(16.7)	20(11.1)	
>61 years	19(31.7)	10(16.7)	7(11.7)	36(20)	
Total	**100**	**100**	**100**	**100**	
AFS (Mean +SE)	6.53(2.11)^{b}	6.90(2.31)^{b}	8.03(1.83)^{a}	7.16(2.79)	**
Land holding (Mean +SE)	0.76(0.03)	1.09(0.04)	1.29(0.05)	1.05(0.03)	*
Experience of beekeeping					
< 5 years	18.3^{a}	6.7^{b}	6.7^{b}	10.6	**
9-15 years	35^{a}	15^{b}	28.3^{ab}	26.1	**
16-20 years	25^{b}	31.7^{a}	35^{a}	30.6	*

> 20 years	21.7[a]	46.7[a]	30[ab]	32.8	**
Total	**100**	**100**	**100**	**100**	
Mean (SE)	11.08[c]±	23.07 [a]	18.78[ab]	17.64	**

*Means on the same row with different superscripts are significantly * different (P<0.05); ;**(p<0.01); N= number of respondents; AFS=Average Family Size, SE=Standard Error; HH= House Hold; ns=non-significant difference*

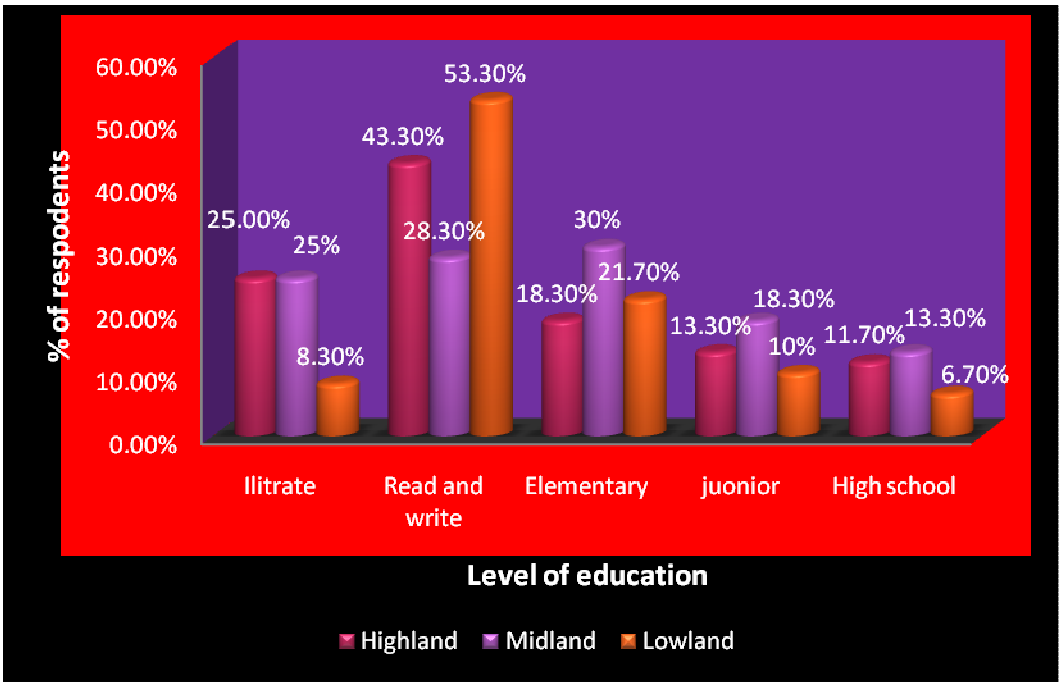

Figure 2 The level of education in the study area

4.2 Major beekeeping activity

4.2.1. Beekeeping practice

According to the result of the study, among the sample household (N=180), 75.9% practice beekeeping using traditional beehives (Table 2). Comparing the three agro ecology, the number of traditional hives is higher (90.3%) in the high land district than in the mid land (75%) and the low land (71.9%) districts. This result is lower than the study conducted in Silti district of SNNPR (Alemayu, 2011) reported (87.07%) of the practice in traditional beehives. This also similar with other findings conducted in the Northern, South Western and Central parts of Ethiopia which showed that traditional beekeeping is predominantly

practiced in most parts of Ethiopia (Kerealem et al., 2009; Kebede and Lemma, 2007; Nuru, 2007). And also the number of traditional hive in the study area was lower than the national average of traditional hive of the country 95% of the hives was traditional (Beyene and David 2007)**.**

Traditional beehives used are mostly cylindrical in shape with the dimensions of about one meter in length and a diameter of around 20 cm. The variability of the shapes of traditional hives is mainly attributed to the climate condition of the area and the differences in honey production systems. Beekeepers of Kembata Tembaro zone construct their traditional hives from different locally available plant species with local name *Hareg (Solanecoangelatus), Shenbeko (Arundinaria alpine).* The internal parts of the hives are plastered with mud and cow dung and the external part is covered with grass, plastic, and Enset (Coba) to protect the hive from rain and other pest (Figure 3).

Based on this finding, 4.6% of the total respondents undertake beekeeping using intermediate hives (Table 2) and it was non-significantly different($P>0.05$) among the three districts. So that this proportion is in line with beekeeping potential as well as promotion and dissemination efforts of respective agro ecologies. Therefore, more efforts are required from all the district Agricultural office to increase the utilization of intermediate hive since it is a bridge to modern hive technology.

According to the result of the study, among the sample household (N=180), 19.4% practice beekeeping using frame beehives (Table 2).Proportionally the number of frame beehives is higher (23.4%) in the low land district than in the mid land (19%) and the high land (7.6%) districts. This result is higher than the result obtained for Silti district of SNNPR (Alemayu, 2011) who reported (11.54%) of the beekeeper practice using frame beehives.

Proportionally frame beehive holding by the respondents in the study areas was lower in the highland area (7.6%) than other districts. This is due to the highland is not suitable for improved box hive. This is situated in cooler climate and at an altitude between 2600 to 3100 m.a.s.l. and with minimum temperature of 11C%. These results in high rate of absconding of honeybees and low yield were absorbed and also less extension work were done in the highland area.

Figure 3 Traditional bee hive of the study areas

Table 2 Honeybee colonies holding by the respondents (year 2013)

Factors	Agro ecology,%				
	Highland	Midland	Lowland	Total	P
	N %	N %	N %	N %	
Traditional	225(90.3)[a]	405(75)[b]	540(71.9)[b]	1170(75.9)	**
Intermediate	5 (2.0)	32(5.9)	35 (4.6)	72(4.6)	ns
Movable	19(7.6)[b]	103(19.0)[ab]	176(23.4)[a]	298 (19.4)	**
Total number	249 (99.9)	540 (99.9)	751 (99.9)	1540(100)	
Mean (TBH)	4.02[c]	7.64[ab]	10.0[a]	7.18	**
Mean (IBH)	1.67	2.29	2.33	2.25	ns
Mean (MFBH)	1.46[c]	3.22[ab]	4.40 [a]	3.51	**

*Means on the same row with different superscripts are significantly * different (P<0.05); ** (p<0.01);ns =no significant difference; N = Number of sampled respondents; ns=no significant difference; TBH = Traditional bee hive; IBH = Intermediate bee hive; MFBH = Movable frame bee hive*

4.2.2 Sources of honey bee colonies to start bee keeping

According to the survey result about 76.7% of the respondents indicated, the major source of bee colony to start beekeeping was through trapping bee colony, 21.1% by gift from parents

and 2.2% by buying (Table 3). The current result was lower than the finding of (Challa, 2010) for Gmma districts of Oromia regional state that established 87.8 % of bee colony obtaining through swarm trapping.

Colony multiplication as means of getting new swarm is not introduced and practiced by any of the beekeepers in the study area. To create supply of sustainable and quality bee colony in the area, colony multiplication technique should be introduced and promoted.

Table 3 Source of foundation colony in the study area

Factors	Agro ecology,%				
	Highland	Midland	Lowland	Overall	P
	N %	N %	N %	N %	
Source of colony					
Trapping bee colony	51(85) [a]	47(78.3)[ab]	40(66.7)[b]	138 (76.7)	**
Gift from parent	9 (15) [b]	11(18.3)[b]	18 (30)[a]	38(21.1)	**
Buying	-	2 (3.3) [a]	2(3.3) [a]	4 (2.2)	**

Means on the same row with different superscripts are significantly * different (P<0.05); ** (p<0.01); N=Numbers of respondents

4.2.3 Placement of honeybee colony

Also it was known that the majority (35.6 %, 84.5% and 83 % with traditional, modern moveable frame and transitional hive, respectively) keep their colonies around their homestead (backyard) (Table 4) and this is mainly to enable close supervision of colonies. Some of the respondents (45.6% and 3.3 % with traditional and intermediate hive respectively) responded for keeping their colonies under the house eave. Whereas, few others (11.7 %, 13.7 % and 15.5 % in traditional, intermediate, and modern moveable from beehive, respectively) keep their colonies inside the bee house (inside a simple shed built for hive placement). Besides, only 7.1% of traditional bee colonies were kept in forests that might have been for the sake of accessibility of bee forages. This result is concurrent with (Workneh, 2007) that reported (84.5%) of the respondents using frame beehive practice backyard beekeeping. Such apiary sites are appropriate for daily activities of beekeeping than the one that is located far away from the home.

Table 4 Placements of honeybee colony by the respondents in study area total sample (N=180)

Placement of bee hive	**Traditional (%)**	**Intermediate (%)**	**Modern (%)**
Back yard	35.6	83	84.5
Under the eave	45.6	3.3	-
Under shade	11.7	13.7	15.5
Hanging in forest	7.1	-	-
Total	100	100	100

N= Numbers of sample respondents

Figure 4 Keeping traditional bee hives under the eve of the house

4.2.4 Reason for involving in beekeeping

According to this study, from total sampled household (N=180), more than 46.1% indicated the reason for involving in beekeeping was for income generation. This result is lower than the result obtained for Burie district of Amahra Region (Tessga 2009) that reported (79.2%).This indicated that in Burie districts the bee keeper was more commercialized.

As per the result of this study high proportion of the household in lowland (61.7%), midland (55%) and highland (21.7%) area practice beekeeping for income generation, respectively (Table 5). The reason behind for the high level of beekeeping engagement in the lowland districts seems existing favourable weather, bee flora abundance and easy access to market that encourage beekeepers to produce and market bee products.

According to this study, 26.7% of the respondents involved in beekeeping activities mainly due to its easiness to perform as compared with other agricultural activities. Whereas, 22.8% for being the practice is inheritance of the family and long-time experience and 4.4% for being advocated by extension agents during basic beekeeping training (Table 5). The current results were similar to the finding of (Nebiyu and Messele, 2013) in Gomogofaa Zone, Southern Ethiopia.

Table 5 Reason for farmer to engage in beekeeping in the study area (n=180)

Factors	Agro ecology,%								
	Highland (n=60)		Midland (n=60)		Lowland (n=60)		Overall (n=180)		P
	N	%	N	%	N	%	N	%	
Reason for involvement of farmer on beekeeping									
-Income generation	13	21.7^{b}	33	55^{a}	37	61.7^{a}	83	46.1	**
- Easy compared to other agricultural	29	48.3^{a}	15	25^{b}	4	6.7^{c}	48	26.7	**
-House experience	14	23.3^{ab}	9	15^{b}	18	30^{a}	41	22.8	*
-Training	4	6.7^{a}	3	5^{a}	1	1.6^{b}	8	4.4	**
Total	**60**	**100**	**60**	**100**	**60**	**100**	**60**	**100**	

*Means in the same row with different superscripts are significantly different (p<0.05), **p<0.01;*p<0.05; n=numbers of sample respondents*

4.3 Honeybee Management practices

4.3.1 Swarming incidences and its managements

Swarming is natural means of increasing bee colonies, and is essential to the continuation of the species. According to this survey results, colony swarming occurs 42.8% in November, 22.8% in September and 21.7% in October months (Table 7). This colony swarming mainly

attributed to immense and diverse availabilities of bee forage source plants. While, February, March, April, July, and December were months in which there was no record of bee colony swarm incidence due to less availability of bee forage on this month. This study result is in agreement with the result of the study conducted in Western Amhara that reported 42.1% November (Assemu *et al.*, 2013). Proportionally season of colony swarming in midland and lowland areas almost similar. For the beekeepers in midland area bee colony swarm occurs 55% of the cases in November and 20% in October and for the beekeepers in the lowland 56.7% in November, 28.3% in October, and for the beekeepers in the highland 38.3% of the record was August and 28% in September(Table 7).

The result also showed that 91.7 % of swarming incidence of honeybee colonies was recorded in the hive during the study years 2013 (Table 6). The current results were similar to the finding of (Alemayu, 2011) in Silti districts, Southern Ethiopia that reported high swarm incidence (97.5%) for the areas. Proportionally in the highland areas (95.5%) more swarming were occurred than midland(91.7%) and lowland(88.3%) areas, respectively this is due less extension work were done on method of prevention in the highland area As the results showed bee colony swarm do have an advantage in increasing the number of colony and to replace non reproductive colony. As well it does also have side effects in causing bee colony weakening that eventual lead to absconding and honey yield reduction. As shown in (Table 6) the most frequently ways of controlling reproductive swarming were 26.1% by removing queen cells, 20.6%, through enlarging hive volume, 5.7% through harvesting or cutting honey combs, 7% by suppering , return back to the colony 5%.But 35.6% of the respondents were recorded no control method in order to prevent swarming of honeybee colony (Table 6). The current finding is similar with the finding of Tessega (2009) that established removal of queen cell as the most widely used method of controlling reproductive swarming by beekeepers in Burie district of Amahra region.

Table 6 Swarm incidences and its managements by the respondents in the study area

Factors	Agro ecology, %						Overall		p-value
	Highland		Midland		Lowland				
	N	%	N	%	N	%	N	%	
Does swarming									
Yes	(57)	95.5[a]	(55)	91.7[a]	(53)	88.3[b]	(165)	91.7	*
No	(3)	5[b]	(5)	8.3[b]	(7)	11.7[a]	15	8.3	*
Methods of control									
Removal of queen cell	(16)	26.7	(17)	28.3	(14)	23.3	(47)	26.1	ns
No control method	(24)	23.3[b]	(30)	50[a]	(20)	33.3[b]	(64)	35.6	**
Suppering	(3)	1.7[b]	(4)	6.7[a]	(6)	10[a]	(130	7.2	*
Cutting of honey comb	(5)	8.3[a]	(2)	3.3[b]	(3)	1.7[b]	(10)	5.6	*
Return back to the colony	(2)	3.3[ab]	(4)	6.7[a]	(3)	1.7[b]	(9)	5	*
Using large volume of hives	(20)	33.3[a]	(3)	5[c]	(14)	23.3[b]	(64)	35.6	**
Total	**(60)**	**100**	**(60)**	**100**	**(60)**	**100**	**(60)**	**100**	

Means on the same row with different superscripts are significantly * different (P<0.05); ** (p<0.01); N=Numbers of respondents, ns=no significant difference

4.3.2 Absconding and reasons for bees absconding

Absconding is a behavioural trait of all honeybees. The term is used when all the bees from a hive leave and desert the combs. Most of absconding occurred in midland and lowland districts were in February to June. Whereas, in highland it was absorbed from December to June (WBoARD, 2012). This might be due to shortage of honeybee forage during this period.

The current finding was in line with the finding of (Amssalu 2006; Gidey and Mekonen 2010) that stated absconding correlates with shortage of honeybee forage. Similarly (Haftom and Tesfay 2012) showed that, shortage of honeybee forage is also indicated as the most

important constraints that hinder the development of beekeeping by triggering bee colony absconding.

In this survey, 56.7% of the household reported the occurrence of absconding while the rest 43.3% did not face the incidence. Agro-ecologically, more absconding honeybee colony was absorbed in highland (65%) than midland (48.3%) and low land districts 56.7% (Table 7).
The reason could be associated with climatic conditions in highland area is too cold and the honeybees cannot resist the cold weather. It was also identified that, incidence of pests (51.1%), shortage of bee forage (31.1%), poor managements(10.6%) and only 7.2% bad weather condition(Table 7) were as possible causes of bee colony absconding in the study areas. This result is in similar with the result of the study conducted in Western Amahra (Adebabay *etal.*2008) that stated incidence of pest, poor management, bad weather as the main causes for bee colony absconding. Hence, farmers should consider feed supplementation and protection of colonies from natural enemies.

Table 7 Absconding and reason for bees absconding from hives and months of swarming

Factors	Agro ecology, %						Overall		p-value
	Highland		Midland		Lowland				
	N	%	N	%	N	%	N	%	
Does absconding									
Yes	(39)	65[a]	(29)	48.3[a]	(34)	56.7[b]	(102)	56.7	*
No	(21)	35[b]	(31)	51.7[b]	(26)	43.3[a]	(78)	43.3	*
Reason for absconding									
Incidence of pests	(21)	35[b]	(35)	58.3[a]	(26)	43.3[ab]	(82)	45.5	ns
Shortage of bee forage	(12)	20[ab]	(10)	16.7[b]	(17)	28.3[a]	(39)	21.7	**
Poor managements	(10)	16.7[a]	(5)	8.3[b]	(5)	8.3[b]	(20)	11.7	*
Bad weather condition	(17)	28.3[a]	(10)	16.7[b]	(12)	20[ab]	(39)	21.7	*
Total	**60**	**100**	**60**	**100**	**60**	**100**	**180**	**100**	
Months of swarming									
September	(17)	28.3[a]	(15)	25[ab]	(9)	15[b]	(41)	22.8	*
October	(10)	16.7[b]	(12)	20[ab]	(17)	28.3[a]	(39)	21.7	*
November	(10)	16.7[b]	(33)	55[a]	(34)	56.7[a]	(77)	42.8	*
August	(23)	38.3[a]	-	-	-	-	(23)	12.8	**
Total	**60**	**100**	**60**	**100**	**60**	**100**	**60**	**100**	

Means on the same row with different superscripts are significantly * different (P<0.05); ** (p<0.01); N=Numbers of respondents, ns=no significant difference

4.3.3 Honeybee feed and Floral Condition

According to beekeepers, there are two peak dearth periods of the year. The dry season (December to March) in which there are bee forage scarcity due to less flowering plants as a source of pollen and nectar. The second one is during rainy season (June to July) in which the pollen of the flowering plants nectar and pollen are washed out and diluted by the rain (BOA, 2008). Out of the total sampled households (N=180), 36.1% have the tradition of providing supplementary feed to maintain the strength of their colony for the later better honey yield (Table 8).

In this study information on the types of feed provided to bee colonies during dearth periods has been collected. Accordingly, supplemental feeding identified were, 16.1% sugar syrup, 14.5% pea flour feed, 29% mixed pea flour and sugar syrup and 40.3% mixed honey, sugar syrup (1: 1 water and sugar) and pea flour (Table 8) and this agrees with Solomon (2009) that came up with 27.8%, 13.9%, 11.4% and 7.6% for sugar syrup, hot pepper, roasted pea flour and honey syrup, respectively.

Table 8 Honeybee feeding practices and type of feed supplement by the respondents

Description	Response	N	%
Existing of bee feeding	Yes	65	36.1
	No	115	63.9
Total		**180**	**100**
Type of feeding	Sugar syrup	10	16.1
	Pea flour	9	14.5
	Pea flour and sugar syrup	18	29
	Honey, sugar syrup and pea flour	25	40.3
Total		**65**	**100**

N=Numbers of sample respondents

In addition to supplementary feeding, planting bee forage is also required to get the intended honey yield. Success in beekeeping depends upon many factors, among them availability of honeybee forage are the fundamental one. Bee forage determines the amount of honey yield obtained. The existence of more bee forage results in high honey production provided that other factors are suitable for honey production. In the study area, there was no bee forage promotion. However, there was an extension activity, which encourages beekeepers to grow indigenous bee forage around backyard.

In the studied areas to identify the major honeybee plants, the respondents had shown their own mechanism to select major honeybee plants for their bees. Understanding of these criteria would help to consider the farmers interest and criteria in introducing and multiplying honeybee plants. To select the major honeybee plants (Table 9) the respondents mentioned

the following criteria such as plant give good quality honey, plants have more number of flowers, plants that give more nectar and/or pollen and long flowering period, plants which have fast growth rate and plants that give flower at different season (more frequency of flowering in a year).Based on this survey result, more than 39 honeybee floras including trees, shrubs, bushes, crops, spices, flowering weeds, and grasses were identified in Kembata Tembaro zone. From the total listed flora types, 9 of them are trees, 17 of them shrubs, and herbs, 10 of them are crops and 3 of them are fruits, respectively (Table 9). List of honey plant species found in the study area are presented in Appendix 1. The scientific names were determined using reference books of Fichtl and Admassu (1994).

Table 9 Major Bee forage plants and their flowering period in KembataTembaro Zone.

No	Scientific name	Common name	Agro ecology	Flowerings time
Shrubs				
1	Dovyalis abyssinica	Koshim	Mid/Highland	March – June
2	Entada abyssinica	Kontir	Mid /High land	August –October
3	*Millettia ferruginee*	Birbera	Mid /High land	January- April
4	*Rubu spp*	Enjori	Mid /High land	March – June
5	*Sesbania sesban*	Sesbania	Mid land	August –October
6	*Syzygium guineense*	Dokima	High/Mid land	April – June
Herbs				
7	*Echinope ssp*	Kosheshila	Mid land	March – April
8	*Bidens sp.*	Adeyabeba	Mid/High land	August-Oct
9	*Guizotia scabra*	Mech	Mid/High land	August -Dec
10	*Negetaa zurea*	Dama-kesi	Mid /High land	January – Dec.
11	*Ocimum basilicum*	Besobila	Mid/High land	August-Dec
12	*Thymus schimperi*	Tosign	Mid/High land	July – Sep.
13	*Trifoliumsteudneri/acaule*	Maget	Mid/High land	August Dec
14	Pinunus communius	Gulo	Mid/Lowland	December
15	Scheffera abyssinica	Gutum	Mid/Highland	March-May
16	Soanecio angelatus	Harege	Mid/Lowland	January-March
17	Hygorophilia auriculata	Amekela	Lowland	Nov-December
Crop				
18	*Allium cepa*	Shenkurt	Mid/High	May –June
19	*Brassica carinata*	Gomenzer	Mid/High land	Sept.-October
20	*Carica papaya*	Papaya	Mid land	Aug-Oct
21	*Cicerarietium*	Shumbura	Mid land	October-Nov.
22	*Coffee Arabica*	coffee	Mid /High land	March-April.
23	*Guizotia abyssinica*	Nuge	Mid/High	Sep.-October
24	*Phaseolusvulgarisl.*	Boleke	Mid /lowland	August – Sep.
25	*Pisum sativum*	Pea/Ater	Mid/High	Sept.-Oct
26	*Solanum tubersum*	Potato	Mid/High	May-June
27	*Viciafaba*	Bakela	Mid/High land	August – Sep.
Fruit				
28	*Persea american*	Abokato	Mid land	Jan- Mar.
29	*Mangifera indica*	Mango	Mid land	Jan-Mar.
30	Mus x paradisiaca	Muze	Lowland	Year round
Tree				
31	*Corotonmacrostachy*	Bisana	March –June	Midland
32	*Cordia africa*	Wanza	Augus-Nov	Mid land
33	*Acacia species*	Girar	March – July	High/Mid
34	*Acacia saligna*	Saligna	Mid /High land	August-Oct
35	*Eucalyptus camadulensis*	Qeyibarzaf	Mid land	March –June
36	*Eucalyptus globules*	Nechbarzaf	High land	March –June
37	*Grevillea robusta*	Grevillea	Mid /High land	August-Nov
38	*Hagenia abysica*	Kosso	High land	Oct.- Nov.
39	*Jacaranda mimosifolia*	yetebemenjazaf	Mid land	Jan – Mar

4.3.4 Inspection of honeybee colonies

Generally beehive inspection by opening is not a common practice in traditional beekeeping. In this study, it was indicated that the frequency of inspecting apiary and honeybee colony was estimated. From the total respondents (N=180), 64.4% frequently do external inspection to their bee colonies, 23.3% sometimes and 12.2% rarely (Table 10). However, it is only 15% of the cases that internal bee colony inspection was done frequently, 53.9% of sometimes and 13% rarely (Table 10). It was also showed that internal hive inspection is limited to those honeybee colonies placed at backyard and under the eaves of the house, and in most cases for Moveable Comb Top-Bar and Moveable Frame hives. The less frequent inspection is presumably because of fear of being stung, the risk of the colony absconding, lack of time and lack of awareness of the value of doing so. Moreover, almost all beekeepers in the study area perform external inspection and also clean their apiary to prevent ant and other insect pests from getting access to hives. The study conducted by (Kerealem et al 2006), (Kerealem et al. 2009), (Nuru 2007) and (Kebede and Lemma 2007) revealed the same results. All these studies confirmed that internal hive inspection of traditional hive is not very common or non-existent at all in their respective study areas, which indeed need to be promoted through training and extension.

Table 10 Percent distribution of frequency of external and internal inspection of apiary in the study area

Inspection frequency	Response	External inspection		Internal inspection	
		N	%	N	%
	Sometimes	42	23.3	97	53.9
	Rarely	22	12.3	56	31.1
	Frequently	116	64.4	27	15
	Total	180	100	180	100

N=Numbers of sample respondents

4.3.5 Types of beekeeping equipment used

Effective bee colony management requires the use of appropriate equipment and accessories, like as modern bee hives, the protective clothing, bee smoker, bee brush and hive tools. Lack

of equipment and protective clothing has been a big hindrance to the adoption of improved beekeeping style that results in low productivity.

According to the respondents most of (92.74%) traditional beekeeping equipment available in the study areas is locally made. This includes smoker, knife and bee brush, queen cage and honey storage containers. Whereas, the remaining (7.26 %) are fabricated (smokers, queen cage and other type of protective clothing) respectively (Table 11). It was also stated that 88.3% of the beekeepers in Burie district of Amahra Region are using homemade bee equipment (Tessega, 2009).

Generally, top bar and moveable frame type hives are demanding more additional beekeeping equipment than traditional hive. Top bar hive beekeeping practices require improved beekeeping equipment like protective cloth, smoker and chisel; and in addition to these moveable frame hive beekeeping requires casting mould, honey extractor and queen excluder. With regard to the type of bee equipment like honey container most of the respondents use none standardized (no food grade) local honey containers, that impact the quality of the products.

The other basic beekeeping accessories required for improved beekeeping technologies like honey extractor and casting mold were observed during the survey being reserved at district FTC (farmer training center) (Table 11). But, they were not in the hand of the respondents probably because of the materials costly nature to have them at individual level. Although it is at high competition, beekeepers have the right to borrow these materials when need arise. Therefore, it is good to increase the number of these commonly used beekeeping materials or create a mechanisms like credit facilities so that beekeeper can get them individually. Unavailability and high cost of beekeeping input are one of the limiting factors to improve beekeeping productivities of the country (Tessega, 2009 and Tewodros, 2010).

Table 11 Types and availability of bee equipment in the study areas (n=180)

NO	Bee equipment type	Available (%)	Unavailable (%)	Total (%)
1	Hive home made	92.7	7.4	100
2	Hive on credit	13.3	86.7	100
3	Hive purchased and locally made	2.5	97.5	100
4	Smoker home made	96.3	3.7	100
5	Smoker purchased on credit	11.3	88.7	100
6	Water sprier homemade	88.9	11.1	100
7	Water sprier purchased on credit	64.5	35.5	100
8	Queen capture homemade	86.8	13.5	100
9	Queen capture purchased on credit	10	90	100
10	Knife homemade	95	5	100
11	Beeswax (pure)	25	75	100
12	Frame wire provided on credit	12.8	87.2	100
13	Frame wire homemade	-	-	-
14	Uncapping fork homemade	-	-	-
15	Uncapping fork purchased on credit	-	-	-
16	Honey extractor locally made and purchased	-	-	-
17	Honey extractor purchased on credit	-	-	Only (4) honey extractors were distributed to each districts by gov.t
18	Casting mold purchased on credit			Only (4) casting mold were distributed to each districts by gov.t
19	Honey container homemade	98.5	1.5	100
20	Honey container locally purchased	1.5	98.5	100
21	Bee brush homemade	94.5	5.5	100
22	Bee brush purchased on credit	7.8	92.2	100

n=sample respondents

4.3.6 Hive products harvesting in the study area

The major honey flow season in the study area is from October to November and the minor flow season is from May to June, and it depends upon the availability of bee forage that in return depends on the amount of rainfall. High availability of honeybee plants from July to November in both midland and lowland**.** Whereas, in the highland area from August to December were recorded (BOA, 2008) unpublished data**.**

Based up on the results of this study, 55% of the beekeepers harvest honeys twice per year (Table13). There was significant difference ($p<0.01$) among the three districts. Both midland (76.7%) and lowland (71.7%) areas of the beekeepers they harvest honey twice per year. However, honey harvesting is done once per year in the highland (83.3%) area beekeepers. Only, 1.7% of the beekeepers said that both in midland and lowland areas were harvesting honey three times per year. This research result is with similar findings with (Challa 2010) in Gomma district where honey harvesting record is once or twice, and in some cases even three times. And also similarly Tessega (2009) reported that farmers in Bure district of Amhara region harvest honey once or twice, and in some cases three times.

In the study areas, 81.1% of the beekeepers produce only honey, 11.1% rear bee colony, and only 7.8% produces beeswax (Table 12) and this agrees with the study conducted in Silti districts (Alemayu, 2011) that came up with 86.95%, 5.45% and 7.60% for honey, bee colony and beeswax production, respectively.

As the result indicated that only few beekeepers (7.8%) are involved in beeswax production. This could be lack of knowledge of its use and how to harvest and absence of demand in the local market was the major reasons.

Harvesting of honey is still traditional in three districts. Virtually all sample farmers use smoking during harvest, the majority of the respondents used smoking material such as, dried cow dung, straw/grass, and worn out cloths. During honey harvesting from traditional hives, beekeepers cut and pull the fixed combs one by one. Pollen, brood, and honey combs were removed and kept in a container and covered with a lid. While, in the case of top bar hives the beekeeper selects combs which contain ripe honey covered with a fine layer of white beeswax, usually those nearest to the rear part of the hives. Combs containing pollen and developing bees are left undisturbed.

Table 12 Types of hive products produced by the respondent in the study areas.

Factors	Agro ecology %						Overall		P-value
	Highland		Midland		Lowland				
	N	%	N	%	N	%	N	%	
Honey	54	90[a]	50	83.3[ab]	42	70[b]	146	81.1	**
Bee colony	4	6.7[b]	5	8.3[b]	11	18.3[a]	20	11.1	***
Bees wax	2	3.3[b]	5	8.3[a]	7	11.7[a]	14	7.8	*
Total	60	100	60	100	60	100	60	100	

Table 13 Honey harvesting frequency per year in the study area (n=180)

Factors	Agro ecology,%				
	Highland (n=60)	Midland (n=60)	Lowland (n=60)	Overall (n=180)	P
Harvesting frequency					
Twice	16.7[b]	76.7[a]	71.7[a]	55	**
Three time	-	1.7[a]	1.7[a]	1.1	*
Once	83.3[a]	21.7[b]	26.7[b]	43.9	***
Total	100	100	100	100	

*Means in the same row with different superscripts are significantly different (p<0.05), ;***p<0.01;***(p<0.001),*p<0.05; n=numbers of sample respondents;*

4.3.7 Post harvesting handling of honey

According to the result of the study, from total sampled household (N=180), only 27.8% of the beekeeper strain honey before sold to market. There was significant difference (P<0.05) among the three districts. As per the result of this study, higher proportion of the household in midland (36.7%), than lowland (26.7%) and highland (20%) areas practice strain honey before selling to market, respectively (Table 14). The current results were similar to the finding of (Alemayu, 2011) in Silti districts of Southern Ethiopia that 38.8% of the beekeeper they strain honey before sold to market. Accordingly, straining materials identified were, 80 % sieves, 12% clothes and only 8% of them use hands to strain honey with the help of solar energy, respectively (Table 14).

Similarly, the majority 72.2% of the beekeeper do not practice staring honey.About, 43.8% lack of strain materials ,23.1% lacked knowledge how to straining honey and 20 % consumer not prefer strain honey and finally only 13.1% of the beekeeper both lack of knowledge and strain materials(Table 14) were as possible causes of not practice of strain honey in the study areas .The current study is in agreement with the study conducted in Gamo Gofa zone of southern Ethiopia (Nebiyu and Messele, 2013) who was reported that lack of strain materials, lacked knowledge and Consumer not prefer strain honey were the major reasons for the beekeeper they do not practice of strain honey.

Table 14 Post-harvest handling activities undertaken by respondent beekeeper

Factors	Agro ecology,%				
	Highland (n=60)	Midland (n=60)	Lowland (n=60)	Overall (n=180)	P
Does strain honey					
Yes	20^{b}	36.7^{a}	26.7^{ab}	27.8	*
No	80^{a}	63.3^{b}	73.3^{ab}	72.2	*
Total	**100**	**100**	**100**	**100**	
Type of material used					
Sieves	75	77.3	87.5	80	ns
Cloths	16.7^{a}	13.6^{ab}	6.2^{b}	12	**
Using hand	8.3	9.1	6.2	8	ns
Total	**100**	**100**	**100**	**100**	
Reason for not staring					
Lack of strain materials	41.7	47.4	43.2	43.8	ns
Lack of knowledge	25	21.1	22.7	23.1	ns
Consumer not prefer Strain honey	22.9^{a}	13.2^{b}	22.7^{a}	20	*
Lack of knowledge & Strain material	10.4^{b}	18.4^{a}	11.4^{b}	13.1	*
Total	**100**	**100**	**100**	**100**	

*Means in the same row with different superscripts are significantly different ($p<0.05$);**$p<0.01$;*$p<0.05$; n=numbers of sample respondents; ns=non-significant difference.*

4.3.8 Storage practices of honey in the study area

Out of the total sampled households, 80 % of them sold honey immediately after harvest (Table 12). This result is different from the study conducted both Burie district of Amahra Region (Tessega, 2009) and Silti district of Southern Ethiopia (Alemayu, 2011). They reported 53.4% and 36.2% of the respondents were sold honey immediately after harvesting; respectively.Because of the early cash requirement to settle past loans, taxes, and other expenses soon after harvest and the consumer gives leas price for honey stored for long period of time.

On the other hand, the study revealed that the remaining, 20 % of respondent's main reasons for on average for 3 to 6 months (Table 15) , honey storage were expectations of better prices (benefit from off-season) and beekeepers do keep some amount of honey for home consumption for different proposes.

In this study, the reason for honey storage mentioned by the sampled households were, 52.8% of them to sale in the time of scarcity honey.It is highest in midland (63.7%) , lowland (50%) and highland(45%) respondents, respectively. Whereas, the remaining 28.9% of them honey storage were to sale the time honey shortage and used for food and medicinal propose(18.3%) ,respectively (Table 15).

This result in the current study is in agreement with the study conducted in Silti Districts of Southern Ethiopia(Alemayu,2011) who reported (50%) of the beekeeper said that the reason for honey storage was to sale in the time of scarcity.

With regarded to type of honey container .out of the total sampled households, 56.1%, 26.1%, 10.6% and 7.2% with plastic container , earth pots , silver materials and gourd pots were used to store honey for short period of time, respectively (Table 15).This result is concurrent with the finding (Challa, 2010) for Gomma districts of Oromia regional state who reported that, majority of the beekeeper they used traditional storage containers such as pots, gourd pots and plastic container, respectively. However, these are technically not appropriate storage facilities as they result in serious quality deterioration.

Table 15 The reason for honey storage and types of container used in the study area

Factors	Agro ecology,%				P
	Highland (n=60)	Midland (n=60)	Lowland (n=180)	Overall (n=180)	
Length of storage					
Do not stored	83.3	71.7	85	80	ns
1-9 month	11.7^{b}	25^{a}	13.3^{b}	16.7	**
Above 1 years	5^{a}	3.3^{ab}	1.7^{b}	3.3	*
Total	**100**	**100**	**100**	**100**	
Reason of storage					
To sale the time of honey Scarcity (better price)	45^{b}	63.7^{a}	50^{ab}	52.8	**
Food and medicine	16.7^{b}	18.3^{b}	20^{a}	18.3	*
To sale the time of honey shortage	8.3^{c}	18.3^{b}	38.3^{a}	28.9	**
Total	**100**	**100**	**100**	**100**	
Type container used					
Plastic container	60^{a}	45^{b}	63.3^{a}	56.1	*
Earthen pot	30^{a}	25^{b}	23.3^{b}	26.1	*
Silver material	3.3^{b}	16.7^{a}	11.7^{a}	10.6	**
Gourd	6.7^{b}	13.3^{a}	1.7^{c}	7.2	**
Total	**100**	**100**	**100**	**100**	

*Means in the same row with different superscripts are significantly different ($p<0.05$),**$p<0.01$;*$p<0.05$; n=numbers of sample respondents; ns=no significant difference*

4.4 Amount of honey yield from different type of hives in the study area

The overall average amount of honey harvested per hive per year from traditional, intermediate and modern hive were 4.31 kg, 9.71kg and 17.8 Kg, respectively (Table 16). There was significantly different ($p<0.001$) among the three districts in honey yield/hive/year. The highest average honey yield from traditional hives in lowland (5.5kg) then followed by midland (4.62Kg) and highland (2.79kg). Similarly, the highest honey yield

from modern hive is in lowland (19.3 kg) then followed by midland (17.3kg) and highland (15.3kg) areas. Whereas, honey yield from intermediate hive in lowland area (12.57kg) is higher than highland (5.67kg) and midland (8.57kg) areas. The present result for honey yield/household/year from traditional hive is lower than the national average yield (8 kg) (CSA, 2008). It is also less than the result reported by Workneh *et al.* (2007) that states 6.5kg as mean honey yield for Atsbi Wemberta district of Tigray Region. But the obtained result for modern hive is greater than the result reported by Alemayu (2011) as average honey yield (14.57kg) in Silti districts for similar beehive type.

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The relatively high mean honey yield record observed in the lowland and midland districts might be attributed to accessibility of the beekeepers to training and applications of improved beehive technologies. In addition, relatively high availability of bee forage in these areas might be an advantage for the reported high yield.

The maximum amount of honey harvested from traditional, intermediate and modern or frame hive were 10, 30 kg and 38 kg, respectively and the minimum outputs from traditional, intermediate and movable frame types of hives in the study areas were 1 kg, 5kg and 8 kg (Table 16). These results are indicators of the existence of room for increasing performances of these beehives through incurring better management practices.

Honey yield per house hold in the study area was 67.25kg/hh/year and there were significantly difference ($P<0.001$) among the three districts. The highest honey yield record per HH was in lowland (111.58kg/HH) area flowed by midland (71.85kg/HH) and highland area (14.10kg/HH) (Table 16). This suggests the presence of better potential for beekeeping in lowland than highland and midland area.

The mean honeybee colony holding in the study areas were 7.91 per HH. It is 10.88 in lowland which is significantly ($p<0.001$) higher than midland (8.52) and highland (4.32) locations (Table 16). Based on the present study the average colony holding of beekeepers is lower as compared to the findings for Bale highlands south east Ethiopia that established 10 colonies as mean per household (Solomon2009). However, it is higher than the mean bee colony holding size (6 per HH) reported for middle Rift Valley Region of Ethiopia (Kebede and Lemma 2007).

Table 16 The amount of honey yield from different hives in the study area

Factors	Agro ecology,%				
	Highland (n=60)	Midland (n=60)	Lowland (n=60)	Overall (n=180)	P
Honey yield (Kg)/hive/HH					
Yield/hive (TBH) (kg)	2.79 ^{c}	4.62^{b}	5.50 ^{a}	4.31	***
Yield/hive (IBH) (kg)	5.67^{b}	8.57^{b}	12.57^{a}	9.71	**
Yield/hive (MFBH) (kg)	15.3^{c}	17.3^{ab}	19.3^{a}	17.8	***
Yield range (TBH) (kg)	1-5	1-8	2-10	1-10	
Yield range (IBH) (kg)	6-8	5-12	6-30	5-30	
Yield range (MFBH) (kg)	8-25	10-30	8-38	9 -31	
Mean/HH (kg)	14.10^{c}	71.85^{b}	115.8^{a}	67.25	***
No of bee colony/HH	**4.32^{b}**	**8.52^{a}**	**10.8^{a}**	**7.91**	*******

*Means in the same row with different superscripts are significantly different (p<0.05), ;***p<0.001;**p<0.01; n=numbers of sample respondents; TBM = Traditional bee hives; IBH = Intermediate bee hive; MFBH = Movable frame bee hives; HH: Household.*

4.5 Trend of honeybee colonies and honey yield in the study areas

Based on the study, the majority of the beekeeper holding colony in traditional bee hives it was estimated about, 75.9 % (Table 1).But, and the trends of familiarization on modern and transitional hive were increasing gradually in midland and lowland districts. Whereas, in highland area almost constant. Based on the information from the total sampled respondents(N=180) honey bee colony number is increasing from the year 2010 to 2013 by 1399 to 1540 (Fig.5) .Similarly, the average number of colony per house holed in the study area was 7.91. This might be due to favourable weather condition, increment of beekeeping participant, and introduction of modern bee hives, a slight improvement of extension service. However, it is yet not satisfactory in relation to its potentiality. This result realizing the

information obtained from woreda agriculture and rural development office which indicated disseminations of improved beehives, mainly movable frame beehives, has increased since 2012/2013 production year, which had a significant contribution in honeybee colony increment specifically both midland and lowland areas. During the survey it was observed that, the number of bee colony was decreased from 1516-1487 in the year 2011-2012(figur.5) due to low level of management practice and technological adoption. Furthermore, the recurrent drought occurrence between three/four years and changing vegetation coverage (i.e., flora) in the area were among other things to be considered as causative factors.

Similarly, the trends of honey yield of the past five years 2010-2013 were increasing from 9426.4 kg to 11404.9 kg (Fig. 6) and the average production of honey/household/year was 67.25kg.As the result s were indicated in (figure 5) that the annual increments honey bee colony in the study area was increased by 2.37% .Whereas, the amount of honey yield was increased by double that is 4.66% per annum (Fig.6). This increase in output over the past four years was due to the growth in hive numbers rather than growth in output per hive, slight improvement of extension serves favorable weather conditions and disseminations of improved beehives were significant contribution to grow honey yield.

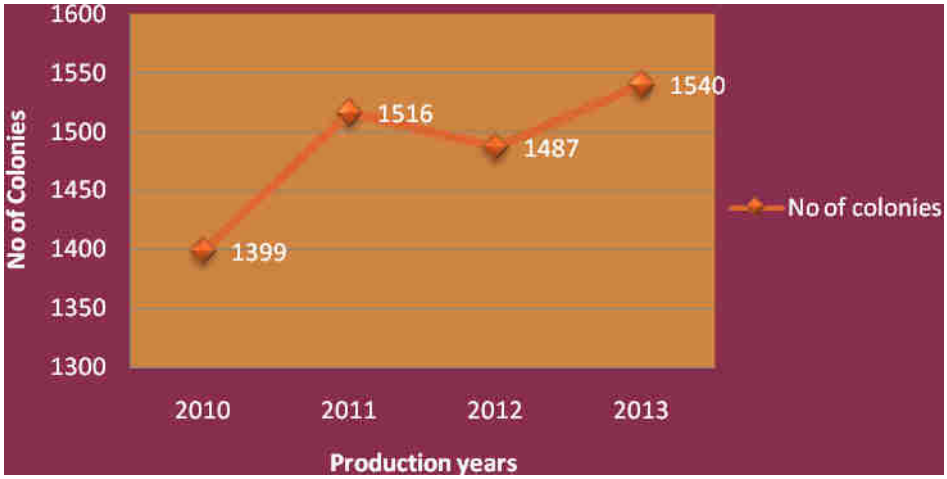

Figure 5 Number of honeybee colonies over the past four years in the study area

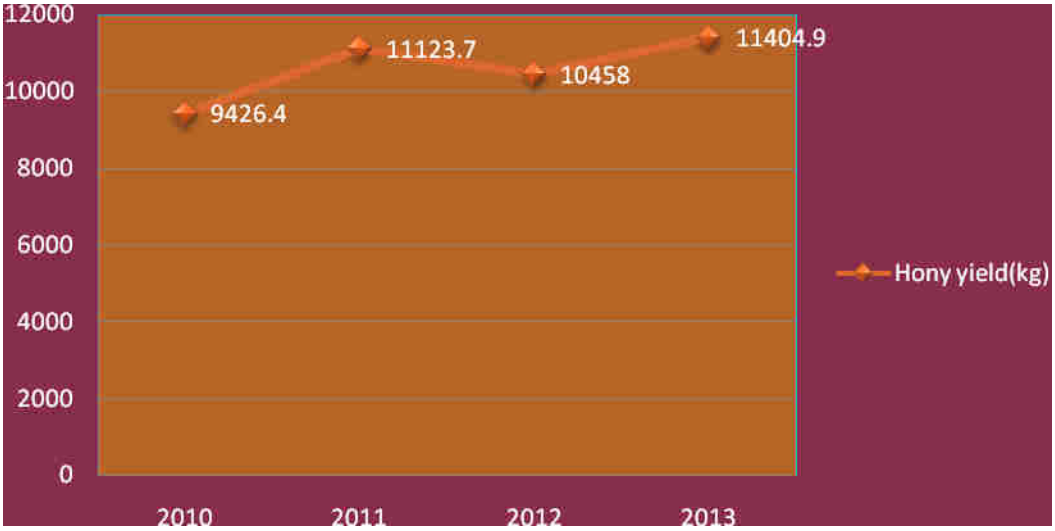

Figure 6 The amount of honey yield (kg) over the past four years in the study area

4.6 Marketing of honey in the study area

Two types of honey have been marketed in the studied district were identified .The first and the largest proportion is crude honey harvested from traditional hives and very small amount of extracted honey harvested from box hives. According to sampled respondents indicated that ,87.2% of the total honey produced in 2013 production year was supplied to the market and the rest 12.8% of honey used for different propose(Table 17) .Out of this, 8.4% used for household consumption and kept for medicinal purposes and only, 4.5 % of them gift to the other person . This result is lower than with the finding of (Tessga, 2009) that states, 98.3% of the sample beekeeper in Bure district reported that they sell honey to market. But, higher than the finding of (Alemayu, 2011) that states, 78.82% of the beekeeper in Silti distrites.

In the study areas, most of honey producers largely sell their honey in the nearest local market area. Specifically, Mudulla (lowland districts) is the most known, Damboya (midland districts) and Doyogena (highland districts), respectively. Out of total sampled respondents, (25.6 %) of beekeepers sell honey at farm gate, (56.7%) of the beekeepers sale at local market. While (17.8%) of them sale their produce at markets found in nearby town and at farm gate (Table 17).

Table 17 Utilization of honey and place of sell by the respondent in the study area

Factors	Agro ecology,%						Overall		
	Highland		Midland		Lowland				p-value
	N	%	N	%	N	%	N	%	
Place of sell honey									
Sell honey at farm gate	17	28.3	15	25	14	23	46	25.6	ns
Local market	33	55^{ab}	32	53.3^{b}	37	61.7^{a}	102	56.7	*
Nearby town and farm gate	10	17.8^{b}	13	21.7^{a}	9	15^{b}	32	17.8	*
Honey utilisation									
Sell to market	49	81.7b	51	85^{ab}	56	94.9^{a}	165	87.2	*
Consumptions & medicinal	8	13.3^{a}	5	8.3^{b}	2	3.4^{c}	15	8.4	*
Gift to other person	3	5	1	1.7	4	6.7	8	4.5	ns
Total	**60**	**100**	**60**	**100**	**60**	**100**	**180**	**100**	

*Means in the same row with different superscripts are significantly different (p<0.05),;*p<0.05; n=numbers of sample respondents;*

4.6.1 Honey marketing channel

In the study areas, different honey marketing participants were identified. This includes producers/farmers, honey collectors, retailers, Tej- houses and final consumers of the product.

Producers:- In the study area, farmers/producers sell their honey to different buyers at village or district market centre. The market place that is the closest to the residence of the farmers is the first choice with regard to minimization of transportation costs and less bargaining power by farmers due to individual marketing because of little amount of honey product, lack of information on honey marketing at other sites.

Honey collector:-The honey collectors found in the study area purchased the honey produce directly from farmers in a small village markets for resell to other collectors, retailers, and consumers who come from different areas of the region at the district market centre.

Retailers: There are shops and other retailers who sell large amount of product and sell it to consumers in small units. These are the final link in the channel that delivered honey to end users, since there were no processors in the study district. The majority of honey retailers found at the woreda centres have their own small stores and retail shops.

Tej- houses: These buy honey mostly from honey collectors and producers**.**

These are also the final link in the channel that delivered honey to consumers.

Consumers: From the consumers' point of view, the shorter the marketing chain, the more likely is the retail price going to be affordable. Consumers for this particular study mean those households who bought and consume honey. They are individual households; they bought the commodity for their own consumption only.

According to Mendoza (1995), marketing channel is the sequence through which the whole of honey passes from farmers to consumers. The analysis of marketing channel is intended to Provide a systematic knowledge of the flow of the goods and services from their origin (Produce) to the final destination (consumer). Therefore, during the survey, the following honey marketing channels were observed (Fig.7).

I. Producer - consumers (41.1%)

II. Producer - honey collectors'- consumers (9.2%)

III. Producer - retailers'- consumers (5.6%)

IV. Producer - honey collectors'- retailers'- consumers (7.5%)

V. producer – honey collector – Tej houses – consumers (14%)

VI. Producer - Tej houses – consumers (22.6%)

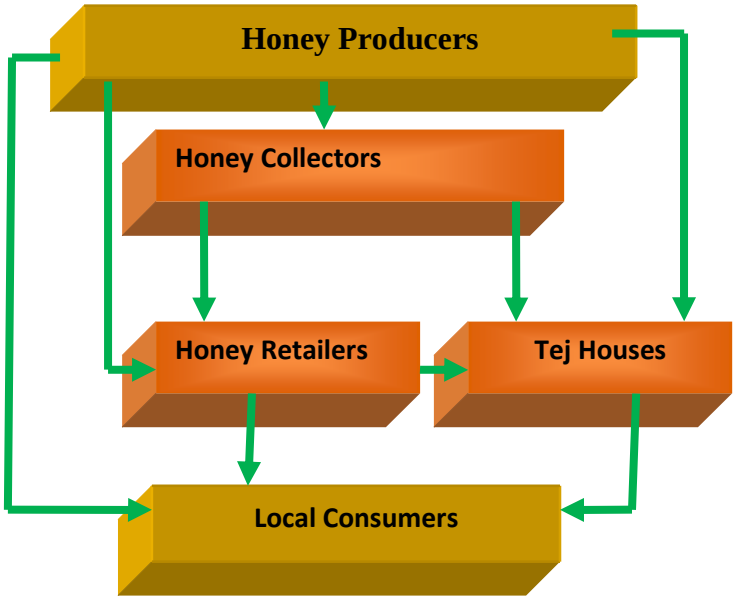

Figure 7 Honey market channel of the study area

4.6.2 Honey price and factors governing the price of honey in the study area

According to the respondents, the price of honey is generally increased over the time due to, increasing demand of honey; consumer number and scarcity of bee fodder largely contribute to the rise in the prices of honey, respectively. The price of honey is subjected to fluctuation with highest price in the off seasons especially during wedding time, holy day (Meskel) and during wet seasons in the period when there was no honey production, respectively. Similarly, they get lowest price during honey harvesting time. Despite, this marketing of honey is promising in the area.

The average price of crude honey and table honey in the study areas were, 29.5 and 51.2ETB per kg, respectively .There was significantly deference ($p<0.001$) among the three districts(Table 18). The highest average price of crude honey was absorbed in lowland (32.4 ETB/kg) then followed by midland (29.6ETB/kg) and finally highland districts 26.4ETB/kg (Table 18). Similarly, the price of table honey in lowland (56.3 ETB/kg) area was higher than midland (50.4 ETB/kg) and highland (46.8 ETB/kg) area, respectively. This due to, the high quality of honey in lowland areas was the major contributing factors to raise the price of honey. The price of crude honey and table honey in the study area was much higher than, the study conducted in Gomma districts (Challa, 2011) who reported that the average price was 15.61 and 21.12 ETB per Kg, respectively.

The price of honey in the study area was reported to vary depending on seasons of the year, colour, taste of the honey, and purity. According to interviewed respondent, the most demanded honey was light (white) in colour, sweet in taste and pure. Honey was considered to be pure if it had fewer amounts of impurities (wing of honeybees, wax, and dead adult bees and brood). Based on the survey result, the most determinant factors governed to the selling price of honey were, 61.1% of the respondents declared that season of the year; honey colour and taste of honey, 26.7% of them colour and test of honey and only 12.2% of test of honey was the most determinant factors for selling price of honey in the study area, respectively (Table 19).

Table 18 The average price of honey from different type of hive in the study area

Factors	Highland (n=60)	Midland (n=60)	Lowland (n=60)	Overall (180)	P
Mean price of Crude Honey (ETB/Kg)	26.4^{b}	29.6^{a}	32.4^{a}	**29.5**	***
Mean price of Table honey (ETB/Kg)	46.8^{b}	50.4^{b}	56.3^{a}	**51.2**	***

*Means on the same row with different superscripts are significantly different ($p<0.05$), n= number of respondents; ETB=Ethiopian Birr; Kg=Kilogram, ***P<0.001*

Table 19 Percentage of factors governing the price of honey in the study area (n=180)

Factor affecting the price of honey	n	% of the respondents
Seasons of the year and Colors and taste of the honey	110	61.1
Colors and taste of the honey	48	26.7
Taste of the honey	22	12.2
Total	**180**	**100**

n=number of sampled respondents

4.6.3 Annual income earned from beekeeping

The mean annual gross income earned in the study area were, 2,053.38 Birr per household (Table.20).There was significantly different ($p<0.001$) among the three districts. The highest in lowland (3648.6 Birr) then followed by, midland (2188.4 Birr) and highland 323 Birr area (Table 20). Based on the present study, the mean annual gross income earned by the beekeeper as compared to the findings for Atsbi Womberta district (Assefa, 2009) that the average annual gross income per household is 3503.74 Birr.

.In the study areas ,45.6% of the beekeepers earned an annual gross income was less than 1000 Birr per annum , 30% of them obtained between 1101 to 5000 Birr per annum and only 1.1% of the beekeeper annual gross income earned greater than 13001 Birr per annum (Table. 20).

Table 20 Per cent distribution of respondents by annual income (2013).

Income category (Per hh/Birr)	Agro ecology,% Highland (n=60)	Midland (n=60)	Lowland (n=60)	Overall (180)	P
<1000	80^{a}	38.3^{b}	18.8^{c}	45.6	***
1001-5000	20^{b}	40^{a}	30^{ab}	30	**
5001-9000	-	21.7^{a}	8.3^{b}	20	**
9001-13000	-	-	10^{a}	3.3	***
>13001	-	-	3.3^{a}	1.1	***
Total	100	100	100	100	
Mean income	323.09^{c}	2188.40^{b}	3648.64^{a}	2053.38	***

*Means on the same row with different superscripts are significantly different ($p<0.05$), n= number of respondents; ***P<0.00;**p<0.01;hh=house hold*

4.7 Access of farmers on beekeeping information and credited

Based on the present study, farmers in the study area get information on doing beekeeping practices from different sources. As it is indicated on table (21) out of the total sampled respondents, 45.6% and 27.3% of them getting information from extension agents and co-

farmers/beekeepers. Farmers were getting information about, 27.2% and 4.4% from radio and other source and only 12.8% of the beekeeper are not get any information, respectively. Apicultural information from co-farmers may be wrong and/or out-dated especially, if they were not well informed on appropriate beekeeping practice and techniques (Table 21).

According to the results of this survey, the effort made so far in facilitating the beekeepers access to appropriate technologies by provision of credit services was minimal. Only, 8% of the beekeeper had access to credit for their beekeeping operations during the past years. The main constraints on using credit were unavailability of credit (86.7%) for beekeeping packages followed by both high interest rates (5.6%), Inaccessibility of credit agents (5.6%) and lack of cash for down payment (2.2%), respectively (Table 21).

During the study period, it was observed that the sustainable land management programme is addressing capital shortage through provision of transitional and frame beehives together with other packages of beekeeping equipment's on credit bases in lowland areas. Moreover, recently a regional finance institution named Omo Micro Finance Institution in collaboration with the district Agriculture Office has initiated a new scheme to facilitate credit for those beekeepers in need of finance to improve their beekeeping production activities.

Table 21 The source of information and access of credit by the respondents in the study area

Factors	Agro ecology,%			
	Highland (n=60)	Midland (n=60)	Lowland (n=60	Overall (n=180)
Source of information				
Extension agent (DA)	46.7	55	35	45.6
Radio	20	18.3	3.3	27.2
Beekeepers/ co-farmers	18.3	3.3	8.3	27.3
None	15	10	13.3	12.8
Others	-	13.3	-	4.4
Total	**100**	**100**	**100**	**100**
Credit accessed				
Yes	4	11	9	8
No	96	89	91	92
Total	**100**	**100**	**100**	**100**
Credit limitations				
Unavailability of credit	91.7	83.3	85	86.7
High interest rate	1.7	6.7	8.3	5.6
Inaccessibility of credit Agents	5	6.7	5	5.6
Lack of cash for down payments	3.3	1.7	1.7	2.2
Total	**100**	**100**	**100**	**100**

n=numbers of respondents

4.8. Pests and Predators in the study area

According to the survey result, in the study area the existence of pests was a major challenge to the honeybees and beekeepers. Based on the information from the respondents were identifying the major pests such as ants, bee- eater birds, wax moth, spider, lizard and honey

badger were the most harmful in order of decreasing importance. Similar results were observed in the central highlands of Ethiopia (Desalegn, 2001) and also by Solomon (2009) in the highlands of south east Ethiopia.

According to the survey result, showed in (Table 22).Out of the total sampled respondents, 28.5% of them in all districts ants were similar effects on honey bees. Which, cause the deaths of adult honeybee and finally absconding of bees were absorbed from their hives. The next serious one is 22.3% of the beekeeper were bee-eater birds attack the bees, mainly during the rainy seasons when there is no grain to feed. About, 18.6% of the respondents had absorbed wax moth in the hives which, results in distraction of honey comb .As there affects in bad smell of the hive and formation of worms.

Whereas, the prevalence of wax moth in lowland districts higher than midland and highland districts. Because, of lowland districts had to hot so the bacteria can grow easily. Followed, by spider (16.6%), lizard (10%) and honey badger (4%) were reported the most harmful can attach honeybees as descending order and the extent of damaging almost similar in three agro ecology. Finally, 4% of the beekeeper is honey badger commonly damage honeybee colonies in the months of November to April when there is brood and honey in the hive.

Based on this survey result, different methods were used by the beekeeper in order to prevent pest such as, keeping the apiary tidy and clean from under growth, avoiding throwing/scattering combs around the apiary site, application of ash around the hive stand, plastering the hive stand with plastic materials, finding and killing predators like bee- eater birds and the queen of ants.

None of the interviewed beekeepers responded for the availability of bee diseases in the study area which, could be due to its absence or lack of awareness about the various symptoms of honeybee diseases.

Table 22 Pest and predators in the study area (n=180)

Types of pest and predators	%	Rank
Ants	28.5	1
Bee- eater birds	22.3	2
Wax moth	18.6	3
Spider	16.6	4
Lizard	10	5
Honey badger	4	6
Total	**100**	

n=numbers of respondents

4.9. Herbicides, Insecticides and Poisonous Plants

According to the survey results, about (90.5%) of interviewed farmers and/or their neighbours had used herbicides and/or pesticides to control crop and livestock pests and diseases. Furthermore, chemicals were sprayed to prevent malaria and weeds. The applied chemicals affected some of the respondents, by causing a decline in honeybee colony population and honey flora resources and finally, minimized honey yield. The herbicides and pesticides are used particularly on wheat and on vegetables such as tomato and cabbage. It is rarely applied to grain crops like maize in time of large infestation with stalk borer and army worm. The time of application varied from area to area it was usually between June and September. Majority of beekeepers appeared to be aware of the toxicity of insecticide and herbicides to bees. None of the beekeepers had taken any measure to protect their bees from the sprayed chemicals. According to the respondents, several plants that are traditionally used as source of pollen and nectar in the area are declining from time to time due to application of herbicides.

There was no report regarding use of safe pest and weed control methods other than those harmful chemicals like Sevin, DDT, Malathion and Roger which cause great harm to honeybees and contaminate their products. Therefore, it is of paramount important to employ integrated pest management techniques and use of lesser hazardous chemicals to control pests and predators, increase soil fertility and agricultural productivity whilst enhancing forage resources for bees and livestock.

In the study area, it was observed that, the knowledge of beekeeper regarding the damage caused by poisonous bee plants on honeybees was comparatively very limited. Only, deaths of field bees were reported under or around the suspected 'plants'. However, there is no evidence whether plant products or pesticide applications poisoned the bees. Generally, damage to colonies of bees from the poisonous nectar or pollen from plants may be severing in one year and of little consequence another time (Robinson and Oertel, 1976).

4.10. Constraints and Opportunities of Beekeeping

As per the result of semi-structured interview supported with focus group discussions and field observations held in each of the study kebeles, the major constraints that hindered the performance of honey production in all districts were mentioned as pest and predators, shortage of bee equipments, shortage of bee forage, high cost of modern hives, Absconding, shortage of train man power, poor extension service, ran fall and pesticide and herbicide application (Table 23).

Among these problems, incidence of pest and predators, shortage of bee equipments and shortage of bee forage were ranked as first, second and third major honey production problems in the study areas, respectively . In the highland area shortage of bee equipments, pest and shortage of bee forage as the first ,second and the third major problems with percentage of rank 28.7%,24.6% and 22.8%, respectively. Similarly the incidence of pest in both midland and lowland areas ranks as first.

This study result, is in line with Kerealem *et al* (2009) who reported that shortage of bee forage, agrochemical poisoning and honeybee pest which, were also reported as the major beekeeping constraints in Amahra regional state. Similarly (Nebiyu and Messele 2013) who reported that lack of beekeeping equipment , shortage of bee colony , high cost of modern hive , Pests and predators , lack of training , shortage of bee forage and absconding were the major honeybee production constraints in Gomogofaa zone , SSNPR.

There is still huge potential to increase honey production and to improve the livelihood of the beekeepers in the all districts, specially, in midland and lowland districts. Based on this, the major opportunities for beekeeping include existence and abundance of honey bee colonies, availability of potential flowering plants, ample sources of water for bees, beekeepers', experience and practices, marketing situation of bee products. Besides this, the existing

natural base, the government has increased its attention to develop the apiculture subsector as one of its strategies for poverty reduction and diversification of export commodities.

Recent initiatives taken by the public and private sectors as well as non-governmental organizations (NGOs) are in the right direction towards improving the possibility of exploiting the potential of the apiculture subsector, and increasing its overall competitiveness through, introduction and promotion of modern hives in order to obtain honey of good quality for industrial processing and export promotion. This opportunity will give a chance to get support to alleviate major constraints hindering apiculture development in the area.

Table 23 Major constraints of honey production in the study areas

Constraints	Study districts %									Overall		
	Highland			Midland			Lowland					
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Pest	24.6	26.7	20.1	44.7	12.8	18.9	43.1	22.1	15	37.4	20.5	18
Shortage of bee forage	9	20	22.8	15.3	18.9	28	16.8	35.6	15.5	13.7	19.2	21.1
Cost of modern hives	11.2	7.4	12.9	12	10.2	15	11.2	10	20.1	11.4	9.2	16
Shortage of bee equipments	28.7	10.3	9	15.4	32.5	20	22	19.7	22.1	18.2	24.2	17
Absconding	9.8	11	9.2	4	13.4	4.3	1.2	1.5	8.5	5	8.6	7.3
Poor extension service	4.1	6.8	10	2.2	5.8	4.4	1	1.8	8.6	2.4	4.5	7.6
Pesticide &herbicide	2.1	0	1.5	5.4	3.4	2.4	1.6	2.5	2.8	3	2.9	2.2
Shortage of training	4.4	8.6	10	1	2	4.5	3.1	6.8	7.4	2.8	5.8	7.3
Rain fall	6.1	9.2	4.5	0	1	2.5	0	0	0	6.1	5.1	3.5
Total	100	100	100	100	100	100	100	100	100	100	100	100

5. SUMMARY AND CONCLUSION

This study covered honey production practices and marketing system of rural households in the three agro ecology area (highland, midland and lowland areas of Kembata Tembaro Zone. Household survey, semi-structured interviews and field observations were used as a main tool for data collection method. The data collected through survey was analysed by using SPSS.

Traditional hive was popular and out of the total sampled respondents, 75.9 %(90.3% highland, 75% midland and 71.9% lowland). Whereas, intermediate hives were 4.6 %(2% highland, 5.9% midland and 4.6% in lowland area).The number of modern hives were 19.3 %(7.6% highland, 19% midland and 23.4% lowland).

Majority of the sampled respondent's households, 84.5% keep their bee colonies at their backyards and their main 76.7% source of bee colony to start and expand beekeeping business was swarm caching. That shows, there was an availability of bee colony in the study area. Assessment of gender indicated that majority 95.6% of the households interviewed were, male beekeepers.

The overall average amount of honey harvested per hive per year from traditional, intermediate and modern hive were 4.31 kg, 9.71kg and 17.8 Kg, respectively. There were significant deference ($P<0.001$) among the three districts in honey yield/hive/year. The highest in lowland for all types of the hives. Similarly, honey yield per house hold in the study area significantly difference ($P<0.001$) among the three districts. The highest average honey yield record per household in lowland (115.8kg/HH) area then flowed by midland (71.85kg/HH) and highland area (14.10kg/HH), respectively. This suggests the presence of better potential for beekeeping in lowland than highland and midland area. The mean honeybee colony holding in the study areas were 7.91 per/HH. It is 10.88 in lowland which is significantly ($p<0.001$) higher than midland (8.52) and highland (4.32) locations

In this survey, 56.7% of the household reported the occurrence of absconding while the rest 43.3% did not face the incidence. Agro-ecologically, more absconding honeybee colonies occurred in highland (65%) than midland (48.3%) and low land districts 56.7%, respectively.

The reason could be associated with climatic conditions in highland area is too cold and the honeybees cannot resist the cold weather.

The majority of the sampled respondents, 80% of them sold honey immediately after harvesting. This, because of high demand for cash and lack of storage facilities. Based on the result, beekeeper from highland (83.3%), midland (71.7%) and lowland (85%) districts sold honey immediately after harvest. On the other hand, the remaining 20% of respondent's main reasons for on average for 1 month to 1 years, honey storage were expectations of better prices (benefit from off-season) and beekeepers do keep some amount of honey for home consumption and different purposes.

According to sampled respondents, (75.6%) of the total honey produced in 2013 production year was supplied to the market and the rest 24.4% of honey used for different propose .Out of this 18.3% of them used for household consumption or kept for medicinal purposes and only 6.1% of them gift to the other person, respectively. In the study areas, different honey marketing participants were identified. This includes producers/farmers, honey collectors, retailers, Tej- houses and final consumers of the product.

The mean annual gross income earned in the study area were, 2,053.38 Birr per household (Table.20).There was significantly different ($p<0.001$) among the three districts. The highest in lowland (3648.6 Birr) then followed by, midland (2188.4 Birr) and highland 323 Birr area. Similarly, the average price of crude honey and table honey in the study areas were, 29.5 and 51.2ETB per kg, respectively .There was significantly deference ($p<0.001$) among the three districts. This difference is may be due to the quality of their product in relation to the way they strained the honey and the physical appearance may be unattractive due to impurities.

Based on this study, the major constraints to exploit the untapped potential of beekeeping activity in the district were pest ,shortage of beekeeping equipment (casting mold, honey strainers, pure beeswax, honey extractors), shortage of bee forage ,high cost of modern hives, absconding, poor extension service, agrochemical poisoning, inadequate accesses to training and excessive rain fall. Furthermore, lack of capital to improved beekeeping technological inputs, lack of honey storage facilities, poor extension service, lack of knowledge on appropriate methods of beekeeping and lack of adequate number of trained experts in apiculture were also the other important limiting factors in the study areas.

This survey has also revealed the existence of many opportunities and potentials for beekeeping in the area. These opportunities and potentials includes: presence of experienced beekeepers and ample honeybee colony in the area. The presence of unexploited resources, *i.e.*, huge water resources, diversified trees and shrubs spp., annual weeds spp. and cultivated crops (horticultural crops, field crops (Pulses, oil crops), spice and stimulant plants), for apicultural development. There is a growing demand for honey and beeswax both at local and international markets. The presence of governmental and non-governmental organizations that are involved in beekeeping activities and the recent involvement of micro finance institutes to finance beekeeping packages are other opportunities. There is also a great potential for diversification of hive products in the study area.

Based on the current finding, the following recommendations can be suggested:

-In order to address the skill gap on bee colony management(including pests and diseases management, bee forage development, colony management, honey harvesting, extraction, processing, etc) such that, practical oriented training should be given .

-To improve the low level of technological input utilization and capital shortage, credit Provision needs to be facilitated to supply improved bee-hives, honey processing materials and other beekeeping equipment.

In order to address the gap of shortage of bee forage there was extension service should be given for the beekeeper to planting of indigenous bee forage around the back yard and introducing improved bee forage in the study areas.

Further studies shall be under taken for confirming species diversity, structure and composition of honey bee flora and poisonous plant to bees.

-The threat of chemical poisoning and the problem of pest and predators in the area should be managed through awareness creation on readily available biological and/or scientifically approved control and prevention methods.

-To improve the gap in extension service delivery and inadequate skills of extension agent in the study area. Practical oriented training should be given.

- To exploit the existing opportunities and potentials of the district, more efforts should be put to create awareness of people on beekeeping.

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7. APPENDICE

7.1. APPENDIX 1. ANOVA AND OTHER TABLES

Appendix Table 1 ANOVA test on family size per household among the study areas

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	73.378	2	36.689	8.3636	***
Errors	776.267	177	4.386		
Total	849.644	179			

*SS= Sum of Squares, MS= Mean Square, DF= Degree of freedom, Sig = Significant value ***P<0.001*

Appendix Table 2 ANOVA test on land holding of the respondent's household

Source of variation	**SS**	**DF**	**MS**	**F**	**Sig.**
Agro ecology	8.541	2	4.271	33.591	*
Errors	22.504	177	0.127		
Total	31.045	179			

SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value; P<0.05*

Appendix Table 3 ANOVA test on the numbers of traditional hives holding/HH.

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	1000.670	2	500.335	9.714	***
Error	8241.171	160	51.507		
Total	9241.840	162			

*SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value*** P<0.001; HH=Household*

Appendix Table 4 ANOVA tests on the numbers of intimidate hive holding/HH.

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	1.143	2	0.571	0.186	ns
Error	88.857	29	3.064		
Total	90.000				

SS= Sum of squares, DF= Degree of freedom, MS =Mean square, ns =non-significant difference

Appendix Table 5 ANOVA test on the numbers of movable hives holding /HH

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	88.948	2	44.474	6.877	**
Error	530.300	82	6.467		
Total	619.247	84			

*SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value**P<0.01; HH=Household*

Appendix Table 6 ANOVA tests on the experiences of beekeeping by the responds.

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	4424.744	2	222.372	35.591	0.000
Error	11002.500	177	62.161		
Total	15427.244				

*SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value*** P<0.001*

Appendix Table 7 ANOVA test on honey yield from traditional hives (Kg)/hive/HH

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	209.214	2	104.607	31.980	0.000
Error	523.363	160	3.271		
Total	732.577	162			

*SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value*** P<0.001; HH=Household*

Appendix Table 8 ANOVA test on honey yield from intermediate hives (kg)/hive/hh in the study areas

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	204.029	2	102.220	5.964	**
Error	497.029	29	17.139		
Total	701.469				

*SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value**P<0.01; HH=Household*

Appendix Table 9 ANOVA test on honey yield from modern hives (kg)/hive /hh.

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	940.988	2	470.494	19.478	***
Error	1980.706	82	24.155		
Total	2921.694	84			

*SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value*** P<0.001; HH=Household*

Appendix Table 10 ANOVA test on honey yield from all hives (kg)/hh.

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	312191.100	2	156095.550	27.843	***
Error	992306.650	178	5574.756		
Total	1304497.750	180			

*SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value*** P<0.001; HH=Household*

Appendix Table 11 ANOVA tests on numbers of bee colony holding /HH

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	1327.244	2	663.622	14.522	***
Error	8134.150	178	45.697		
Total	9461.394	180			

*SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value*** P<0.001*

Appendix Table 12 ANOVA tests on average annual income earned (birr) form sealing of honey /hh.

Source of vibration	SS	DF	MS	F	Sig.
Agro ecology	333419005.4	2	2166709502.7	26.439	***
Error	1122328702	178	6305217.122		
Total	1455747707	180			

*SS= Sum of squares, DF= Degree of freedom, MS =Mean square, Sig = Significant value*** P<0.001; HH=Household*

Appendix Table 13 Major bee forage plants and their flowering period in kembata tembaro zone.

	Scientific name	Common name	Agro ecology	Flowerings time
Shrubs				
1	Dovyalis abyssinica	Koshim	Mid/Highland	March – June
2	Entadaabyssinica	Kontir	Mid /High land	August –October
3	*Millettia ferruginee*	Birbera	Mid /High land	January- April
4	*Rubu sspp*	Enjori	Mid /High land	March – June
5	*Sesbania sesban*	Sesbania	Mid land	August –October
6	*Syzygium guineense*	Dokima	High/Mid land	April – June
Herbs				
7	*Echinope ssp*	Kosheshila	Mid land	March – April
8	*Bidens sp.*	Adeyabeba	Mid/High land	August-Oct
9	*Guizotia scabra*	Mech	Mid/High land	August –Dec
10	*Negetaa zurea*	Dama-kesi	Mid /High land	January – Dec.
11	*Ocimum basilicum*	Besobila	Mid/High land	August-Dec
12	*Thymus schimperi*	Tosign	Mid/High land	July – Sep.
13	*Trifoliumsteudneri/acaule*	Maget	Mid/High land	August Dec
14	Pinunus communius	Gulo	Mid/Lowland	December
15	Scheffera abyssinica	Gutum	Mid/Highland	March-May
16	Solanecoangelatus	Harege	Mid/Lowland	January-March

17	Hygorophiliaauriculata	Amekela	Lowland	Nov-December
	Crop			
18	*Allium cepa*	Shenkurt	Mid/High	May –June
19	*Brassica carinata*	Gomenzer	Mid/High land	Sept.-October
20	*Carica papaya*	Papaya	Mid land	Aug-Oct
21	*Cicerarietium*	Shumbura	Mid land	October-Nov.
22	*Coffeaarabica*	coffee	Mid /High land	March-April.
23	*Guizotiaabyssinica*	Nuge	Mid/High	Sep.-October
24	*Phaseolusvulgarisl.*	Boleke	Mid /lowland	August – Sep.
25	*Pisum sativum*	Pea/Ater	Mid/High	Sept.-Oct
26	*Solanum tubersum*	Potato	Mid/High	May-June
27	*Viciafaba*	Bakela	Mid/High land	August – Sep.
	Fruit			
28	*Perseaamerican*	Abokato	Mid land	Jan- Mar.
29	*Mangiferaindica*	Mango	Mid land	Jan-Mar.
30	Mus x paradisiaca	Muze	Lowland	Year round
	Tree			
31	*Corotonmacrostachy*	Bisana	March –June	Midland
32	*Cordiaafrica*	Wanza	Augus-Nov	Mid land
33	*Acacia species*	Girar	March – July	High/Mid
34	*Acacia saligna*	Saligna	Mid /High land	August-Oct
35	*Eucalyptus camadulensis*	Qeyibarzaf	Mid land	March –June
36	*Eucalyptus globules*	Nechbarzaf	High land	March –June
37	*Grevillearobusta*	Grevillea	Mid /High land	August-Nov
38	*Hageniaabysica*	Kosso	High land	Oct.- Nov.
39	*Jacaranda mimosifolia*	yetebemenjazaf	Mid land	Jan – Mar

Appendix 3

8. QUESTIONNAIRES

1. Questionnaire Used for the Study

I.General Information from Household

I. General Information

1.1. Name of Enumerator _____ 1.2. Date of interview_____

1.3. Kebele _____ 1.4. Village (Gote) _____

1.5. Altitude of the PA_____1.6. Total Population of the PA_____ (M__F___)

1.7. No. of Households in a PA_____1.8. No. of beekeepers in PA _____ (M_F__)

II. Household Characteristics

1. Name of house hold head_____

2. Sex: 1. Male 2. Female

3. Age (yrs): _____

4. Religion of household 1. Orthodox 2.Muslim 3.Protestant 4. Catholic

Other, specify

5. Education: 1. Illiterate 2.Ku'ran 3. Reading and Writing 4. 1-8 grade 5. 9-12 grade

6. Marital status: 1. Married 2. Single 3.Widowed 4.Divorced 5. Polygamous

7. Family size Total_____ Male_____ Female_____

8. No of children _____Other family member _____

V. Credit Sources and Availability

15. Do you ever-obtained credit for your farming operations? 1. Yes ___ 2. No_____

16. If yes, for what purposes you get credit? _____

17. Who are / were your sources of credits? (Circle one or more).

1. Micro finance institutions (name it): _____

2. Service cooperatives 5. Relatives

3. Ministry of Agriculture 6. Individual lenders

4. NGO 7. Others, specify: _____

18. Do you receive credits for your farming activities during this cropping season?

1. Yes _____ 2. No _____

19. If yes, for what activities you are using the credit? _____

20. .if you received credit for beekeeping during the last five years indicate amount and purpose

Year	Amount	Purpose*
2000		
2001		
2002		
2003		
2004		

* Purpose: 1. To buy Frame hive 2. To buy Top bar hive 3. To buy transitional hive 4.To buy Bee colony 5. Other specify_____

21. Do capital/ cash or credit is limiting to use improved beekeeping technologies?

1.Yes___ 2. No___4.3.1. If yes, for what activities you are using the credit? _____

22. What are the major problems you face to get input on credit?

22.1. Inaccessibility of credit agents 1. Yes _____ 2. No _____

22.2. Debit collection problem 1. Yes _____ 2. No _____

22 .3. High interest rate 1. Yes _____ 2. No _____

22.4. Unavailability of credit 1. Yes _____ 2. No _____

22.5. Others, specify: _____

A. Beekeeping Activities and Potentials

23. Honeybee ownership

23.1. Do you keep honeybees? 1. Yes _____ 2. No_____

23.2. If yes, when did you start beekeeping? _____year (s).

23.3. How you start beekeeping? Source of bees and type of technologies used for the 1st time.

No	Sources	Quantity	Traditional	Intermediate	Movable-frame
1	Gift from parents				
2	Catching swarms				
3	Buying				
	Trained				
5	Interest				
6	NGOS				
7	Governments				

23.4. If the answer for question 23.3 is buying, does the bee colony sale in yourlocality? 1. Yes _____ 2. No_____

23.5. If yes, what is the price of one colony? _____ ETB

23.6. How many honeybee colonies you owned?

No	Years	Traditional		Intermediate		Movable-frame	
		No	Produce*	No	Produce*	No	Produce*
1	2010						
2	2011						
3	2012						
4	2013						

*Total production of honey (kilograms)

24. Where did you keep your bee colonies?

No	Site or placement of hive	Traditional	Intermediate	Movable-frame
1	Backyard			
2	Under the eaves of the house			
3	Inside the house			
4	Hanging on trees near homestead			
5	Hanging on trees in forests			
6	Others (specify)			

25. For how many years your colony remains or stays in the hive?

1. Traditional: Minimum _____year (s) Maximum _____years

2. Intermediate: Minimum _____year (s) Maximum _____years

3. Movable-frame: Minimum _____year (s) Maximum _____years

26. Do you have empty beehives? 1. Yes _____ 2. No_____

27. If yes, list the number of empty hives you have.

No	Types of beehives	Numbers	Reasons (use causes in question 5.1.10.2)
1	Traditional		
2	Intermediate		
3	Movable-frame		

28. What is the trend of your colony number and honey yield (in question 27)?

No	Types of beehives	No harvest	Increasing	Stable	Decreasing
1	Traditional				
2	Intermediate				
3	Movable-frame				

29. If there is an increase in trend in number of bee colonies and honey yield over the years, what are the causes?

29.1. Good market price 1. Yes _____ 2. No_____

29.2. Added more bee colonies 1. Yes _____ 2. No_____

29.3. Use of new technologies 1. Yes _____ 2. No_____

29.4. Others (specify) _____

30. If there is a decrease in trend in the number of bee colonies and honey yields over the year, what are the causes in order of importance?

No	Causes	Rank	Season of occurrence	Measures taken
1	Lack of bee forage			

2	Lack of water			
3	Drought (lack of rainfall)			
4	Migration			
5	Absconding			
6	Pests and predators			
7	Diseases			
8	Pesticides and herbicides application			
9	Death of colony			
10	Decrease in price of honey			
11	Increased cost of production			
12	Luck of credit			
13	Others (specify)			

31. Did your colonies abscond? 1. Yes_____ 2. No_____

32. What are the reasons for bees absconding hive? _____

33. If drought is a problem how is its frequency of occurrence? Every____year(s)

34. What are the major pests and predators found in the area that threat your colonies? List in order of importance.

No	**Pest /Predators**	**Rank**	**season they damage bees and/or bee products**	**Local control methods**
1	Ants			

2	Wax moth			
3	Bee lice			
4	Beetles			
5	Spiders			
6	Wasps			
7	*Prey mantis*			
8	Toads			
9	Lizard			
10	Snake			
11	Monkey			
12	Birds			
13	Hama got /Shelemetmat/			
14	Others (specify)			

***Preventive measures** 1. No measure 2. Use of insecticides 3.Killing the pests using fire 4. Cleaning the apiary 5.Use of smooth iron sheet on the hive stand 6. Tin filled with used engine oil 7. Use mud and ash at hive stand 8. Others (specify)

35. Do you observe any honeybee diseases in your apiary? 1. Yes____ 2.No____

36. If yes, what are the diseases you observed?

No	**Local name**	**Stages of bee affected**				**Incidence period**	**Local control measure/s**
		Adult	**Symptoms**	**Brood**	**Symptoms**		
1							
2							
3							
4							

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

37.1. Traditional 1. Yes _____ 2. No_____

37.2. Intermediate 1. Yes _____ 2. No_____

37.3. Movable-frame 1. Yes _____ 2. No_____

38. Do you use agrochemicals/chemicals in your locality? 1. Yes __ 2. No___

39. If yes, why do you apply agrochemicals/chemicals?

1. Crop pests control 1. Yes _____ 2. No_____

2. Weeds control 1. Yes _____ 2. No_____

3. Malaria control 1. Yes _____ 2. No_____

4. Tsetse fly control 1. Yes _____ 2. No_____

5. Others (specify): _____

40. When do you use agrochemicals/chemicals (months)? _____

41. What type of agrochemicals/chemicals are farmers using? _____

_____

42. Do agrochemicals/chemicals affect your honeybees? 1. Yes __ 2. No__

43. If yes, how many colonies did you lost due to chemicals? _____When?

(Year and months):_____

44. What is the estimated honey you lose? _____kg..

45. What will be the estimated price? _____ETB

46. What measures do you take to protect your bee colonies from agrochemicals?

/chemicals?

_____

47. What are the sources and costs of the beehives you used?

No	Items	Traditional	Intermediate	Movable-frame
1	Constructed by himself/herself			
2	Constructed locally and bought			
3	Bought from market			
4	Supplied by governments			
	On credit basis			
	Free of charge			
5	Supplied by NGO's			
	On credit basis			
	Free of charge			
6	Price of one hive (ETB)			
7	Service time (years)			

48. List the types of traditional beehives you used.

No	Types of materials made	Shape	Length	Diameter
1				
2				
3				
4				

49. Have you practiced honey hunting? 1. Yes _____ 2. No _____

44.1. If yes, in which month (s) and year (s)? _____

B. Vegetation, honey plants and water availability

45. What are the major honeybee floras in your area? List in terms of priority?

No	Local/ Common name of the plant	Type of the plant (Tree, shrub, herb, cultivated crop)	Flowering time (months)	Source (nectar, pollen, propolis)	Other uses 1. feed 2. medicine
1					
2					
3					
4					
5					
6					

46. Is there honeybee Feed shortage? 1. Yes_____ 2. No_____

47. If your answer for question is yes, in which month(s) of the year it occurs? _____

48. Do you give additional feeds to your bees? 1. Yes 2. No

49. If your answer for question is yes, when do you give additional feeds to your bees___?

50. If your answer for question is No, why? ----------

51. What type of feed do you give to your bees?

1. Honey 2. Pea flour 3. Sugar syrup 4. Chick pea flour 5. Barley flour

6. Hot pepper 7.Others (specify)

52. Do you plant bee forage? 1. Yes ____ 2. No.___

53. If yes, please list the name of the plants and Total in ha (number of seedling)

No	Name of plant	Total area(ha)	Number of seedling

54. Is there any poisonous plant to bees in your area? 1. Yes_____ 2. No. ___

55. If yes, mentioned these poisonous plants and their flowering time.

No	**Local/ Common name of the plant**	**Type of the plant (Tree, shrub, herb, cultivated crop)**	**Flowering time (months)**	**Source (nectar, pollen, propolis)**	**Effects on 1. bees 2. human**
1					
2					
3					
4					
5					

56. Does water available for your honeybees at all the time? 1. Yes___ 2. No__

57. If yes, where do your honeybees get water? (Circle one or more)

1. Streams 2.Rivers 3. Lakes 4. Ponds 5. Water harvesting structures

6. Others: specify_____

58. If your response is no, how do you provide water to your bee colonies?_____

C. Beekeeping equipment's and protective materials

59. Which of the following beekeeping equipment and protective materials you have or available to you when ever required?

No	Materials	Home made	Locally made and purchased	Provide on credit (purchased)	Donated by GO or NGO's	Price (ETB)		Service period (years)
						rrent	purchase	
1	Smoker							
2	Veil							
3	Gloves							
4	Overall							
5	Boots							
6	Water sprayer							
7	Bee brush							
8	Queen catcher							
9	Queen excluder							
10	Chisel							
11	Knife							
12	Embeder							

13	Frame wire							
14	Honey presser							
15	Beeswax (pure)							
16	Casting mold							
17	Uncapping fork							
18	Honey extractor							
19	Honey strainer							
20	Honey container							
	Others							

60. What are the smoking materials you are using? (Rank) Dry grass, straw, cow dung

Rank: 1st _____ 2nd _____ 3rd_____ 4th_____

D. Management and Honey harvesting

61. Do you visit and inspect your beehives and colonies? 1. Yes___2. No_____

62. If yes, which type of inspection you perform?

62.1. External hive inspection 1. Yes _____ 2. No_____

62.2. Internal hive inspection 1. Yes _____ 2. No_____

63. Frequency of inspection

63.1. External hive inspection: (circle one or more)

1. Frequently 2. Sometimes 3. Rarely

63.2. Internal hive inspection: (circle one or more)

1. Frequently 2 .Sometimes 3. Rarely

64. If no inspection, what is the reason? _____

65. Do you clean your apiary? 1. Yes 2. No

If no why? _____

66. When the following major activities occur in your locality?

No	Major activities	Season(s) of occurrence			
		September to November	**December to February**	**March to May**	**June to August**
1	Brood rearing period				
2	Colony Swarming				
3	Colony Migration				
4	Colony Absconding				
5	Honey flow season				
6	Honey harvesting time				
7	Dearth period				

67. Does swarming occur in your colonies or locality? 1. Yes_2.No__

68. If your response is yes, what is the frequency?

1. Every season 1. Yes _____ 2. No_____

2. Every year 1. Yes _____ 2. No_____

3. Once in two years 1. Yes _____ 2. No_____

4. Others, specify: _____

69. When does swarming occur more frequently? (Months)

From_____ to _____

70. Is swarming advantageous to you? 1. Yes _____ 2. No_____

71...If yes, describe the reason(s)

1. To increase my number of colony 1. Yes_____ 2. No___

2. to sale and get income 1. Yes _____ 2.No_____

3. To replace non-productive bee colonies 1.Yes___2.No__

4. Others specify: _____

72. Do you control / prevent/ swarming? 1. Yes_____ 2. No_____

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

1. Removal of queen cells 1.Yes _____ 2. No_____

2. Harvest or cut honey combs 1.Yes _____ 2. No_____

3. Return back to the colony 1.Yes _____ 2. No_____

4. Supering 1.Yes _____ 2. No_____

5. Using large volume hive 1.Yes _____ 2. No_____

6. Others, specify: _____

74. Do you have swarms catching experience? 1. Yes _____2. No____

74.1 If yes, do you use swarm attractant materials? 1. Yes__2.No_

74.2 If your response in question 74.1 is yes, describe what types of attractants and methods of application you use (rank them).

No	Attractant materials	Sources	Methods of application
1			
2			
3			
4			

75. How many swarms do you catch in this production year? _____

76. What kind of beehive products you produce?

No	Products	Traditional	Intermediate	Movable-frame	Honey hunting
1	Honey				
2	Crude beeswax				
3	Propolis				
4	Others, specify				

77. List the amount of your beehive products and frequency of harvest per annum.

No	Types of beehives	Honey production		Crude beeswax		Propolis	
		Kg/hive	Frequency	Kg/hive	Frequency	Kg/hive	Frequency
1	Traditional						
2	Intermediate						
3	Movable-frame						

4	Honey hunting						

78. While harvesting does you remove all honeycombs? 1. Yes _____ 2. No___

79. Do you harvest all brood combs? 1. Yes _____ 2. No_____

79.1If no how much honey /no of combs/ left? _____

80. While harvesting does your bee colony evacuate? 1. Yes _____ 2. No____

81. List the home use of honey.

1. as a food 1. Yes _____ 2. No_____

2. as a medicine 1. Yes _____ 2. No_____

3. for beverages 1. Yes _____ 2. No_____

4. for cultural and ritual ceremonies 1. Yes _____ 2. No_____ 5.others

82. If you collect crude beeswax list the sources.

1. Empty honeycomb during harvesting 1. Yes _____ 2. No_____

2. Discarded, old and broken combs 1. Yes _____ 2. No_____

3. Uncapping and spout beeswax 1. Yes _____ 2. No_____

4. From colony absconding hives 1. Yes _____ 2. No_____

5. after home utilization of honey 1. Yes _____ 2. No_____

6. Others, specify _____

83. Why you are collecting crude beeswax?

1. For income generation 1. Yes _____ 2. No_____

2. Candle making 1. Yes _____ 2. No_____

3. Foundation sheet making 1. Yes _____ 2. No_____

4. Religious and cultural use 1. Yes _____ 2. No_____

5. Others, specify:_____

84. If you don't collect/produce beeswax what is (are) the reason (s)?

1. Lack of market 1. Yes _____ 2. No_____

2. Lack of knowledge 1. Yes _____ 2. No_____

3. Lack of processing skills 1. Yes _____ 2. No_____

4. Lack of processing materials 1. Yes _____ 2. No_____

5. Others specify: _____

85. Do you collect propolis? 1. Yes _____ 2. No_____

85.1 If yes, for what purpose you are using the propolis?

1. For sale (marketing) 1. Yes _____ 2. No_____

2. as a medicine to treat diseases 1. Yes _____ 2. No_____

3. Others specify: _____

86. If your response is no, what is (are) the reason (s)?

1. Lack of market 1. Yes _____ 2. No_____

2. Lack of knowledge 1. Yes _____ 2. No_____

3. Others specify: _____

87. Describe the utilizations of your beehive products.

No	Types of products	Total %	Percentage of product utilized of				
			HH* consumption	Sale	Wages in kind	Gift	Others
1	Honey						
2	Beeswax						

3	Propolis						

*Household

88 .Did they use beeswax 1) yes 2) no

88.1 If yes for what purpose? .....

E. **Post-Harvest Management**

89. Do you strain your honey? 1. Yes _____ 2. No_____

89.1. If yes, what materials do you use for straining?

1. Honey extractor 2. Honey presser 3. Cloth 4. Sieve 5. Decantation

6. Using hand

90. If you strain, what is the advantage and price of 1 kg strained honey?

91.1. Advantage: _____

91.2. Price of 1 kg strained honey: _____ETB

91. If you don't strain your honey why? (Circle one or more).

1. Lack of materials

2. Lack of knowledge how to strain

3. Consumer do not prefer strained honey

4. The amount of honey will be reduced if strained

5. Others specify: _____

92. For how long do you store your honey? (Circle one or more).

1. I don't store, I will sale / it will be consumed during harvesting

2. One to six months 3. Seven to twelve months

4. One year to two years 5. More than two years

93. for what reason do you store honey? _____

94. What is the maximum storage year of your honey? _____Years.

95. List the container you have been used to store your honey, price, service years and problems you have been encounter.

No	Types of container used	Price (Birr)	Service (years)	Problems observed by using it
1	Gourd /kele/			
2	Earthen pots			
3	Tin /silver metal/			
4	Plastic container			
5	Animal skin and hide			
6	Others (specify)			

96. If your honey is crystallized, did you change it to viscous honey? 1. Yes __ 2. No___

97. If yes, what methods do you use? (Put circle)

1. Direct heating using fire 2. Putting in a boiled water bath 3. Using sunlight

4. Others, specify:_____

F. Marketing Condition

98. Do you sale your honey? 1. Yes 2. No

99. What is the annual income from sale of hive products?

No	Types of produce	Quantity	Unit price (Birr)	Total price (Birr)	When do you sell**
1	Honey				
2	Crude beeswax				

3	Propolis				
4	Bee colonies				

**1. At harvesting 2. -------- Month after harvesting

100. What are the factors that govern the price of the honey in your locality?

1. Seasons of the year 2. Colors and taste of the honey

3. Distance from market 4. Traditional ceremonies 5. Others (specify):

101. During this harvesting season what is the price of 1 kg of honey?

No	**Color of honey**	**Price of honey (Birr/kg) produced from:**		
		Traditional hive	**Intermediate hive**	**Movable-frame hive**
1	White			
2	Yellow			
3	Red			
4	Brown			
5	Mixed			

102. Who are your customers?

1. 'Tej' houses 2. Middlemen 3.Retailers 4.Wholesalers 5. Consumers

6. Beekeepers co-operative 7. Others /specify/ _____

103. How do you evaluate the local market price? 1. High___2. Medium___3. Low___

104. How is the price trend of honey in your locality?

No	**Price trend**	**Reasons**

1	Increasing	
2	Stable	
3	Decreasing	

105. How did you fix the price of honey?

1. Consideration labor and other cost incurred 2. Market force (supply and demand)

3. Color of honey 4. Table honey and crude honey 5. Customs and Traditional ceremonies

6. Others (specify_____

106. Where is your major sell place? (More than one answer is possible)

1. In your home 2. Nearby market place 3. Major honey market place 4. Beekeepers cooperatives 5. Other (specify)_____

107. What is the demand of honey in the market?

1. Very high 2. High 3. Medium 4. Low 5. Very low

108. What is the supply of honey in the market?

1. Excess 2. Enough 3. Not enough

109. Which honey is more wanted in the market?

1. Pure extracted honey from box hives 2. Pure strained honey from KTBH

3. Crude honey from KTBH 4. Crude honey from traditional

110. Do people adulterate honey? 1. Yes___ 2. No ____

111. What sort of additives do people use to adulterate honey? _____

112. Does beekeeping profitable to the area? 1. Yes _____ 2. No_____

G. Constraints of beekeeping

113. What are the major constraints of beekeeping in the area? (Rank them)

No	Constraints	Rank	What measures will be taken?
1	Bee hives		
2	Beekeeping equipment's / materials		
3	Honeybee colony		
4	Shortage of bee forage		
5	Shortage of water		
6	Drought (lack of rainfall)		
7	Absconding		
8	Pests and predators		
9	Diseases		
10	High temperature		
11	High wind		
12	High rainfall		
13	Pesticides and herbicides application		
14	Death of colony		
15	Migration		
16	Swarming		
17	Storage facilities		
18	Marketing		
19	Others (specify)		

H. Beekeeping extension

114. Do you have contact with extension agent? 1. Yes_____ 2. No_____

114.1. If yes, how many times do you contact per month? _____per month

115. Who assisted you in improving your beekeeping production activities? Show in rank and type of assistance provided. (Circle the response(s))

1.Agricultural and Rural development___ 2. Non-Governmental Organization

3. Research Center 4.Neighbour___ 5.Relatives__ 6. Others specify _____

116. Which extension media helped you most to learn about beekeeping? (Circle the response(s))

1. Extension agent 2. Radio 3. Field day 4. Television 5. Printing materials

6. Co-farmers

117. Did you ever get beekeeping training? 1. Yes _____ 2. No_____

118. If yes, from where did you got the training? (Circle the response(s))

1.Researchcentres 2. Agricultural and rural development

3. Non-Governmental Organization (NGO) 4. Any other (specify)_____

119. If yes, on what area did you get training? (Circle the response(s))

1. Colony multiplication 2. Bee management 3. Hive products 4. Marketing

5. Any other (specify) _____

120. If yes, did you find the training useful? 1. Yes _____ 2. No_____

121. What changes in the training would have made it more useful? (Circle the response(s))

1. Understanding effective way of using beekeeping technologies

2. Understanding improved beekeeping management (feeding, inspecting, supering)

3. Any other (specify)_____

123. If yes, can you apply the training practically? 1. Yes _____ 2. No_____

122. If no, what was wrong with the training?

1. It focuses only on theory 2. The training duration is too short 3.Lack of experienced trainer 4. It was not based on my need 5. Any other (specify) _____

125. If your response for question 120 is no, do you need beekeeping training?

1. Yes ___ 2. No____

Compiler Name: _____

Signature: _____

Date: _____

Duration: Starting time _____ Ending time----------