BAHIR DAR UNIVERSITY

COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

POST GRADUATE PROGRAME

CHARACTERIZATION OF HONEY PRODUCTION AND MARKETING SYSTEMS, CHALLENGES AND OPPORTUNITIES IN ADA BERGA DISTRICT, WEST SHOA ZONE, OROMIA, ETHIOPIA

M.Sc. Thesis
By:

Etenesh Mekonnen

November, 2016
Bahir Dar, Ethiopia

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (M.Sc.) IN "APICULTURE"

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THESIS APPROVAL SHEET

As member of the Board of Examiners of the Master of Sciences (MSc) thesis open defense examination, we have read and evaluated this thesis prepared by Etenesh Mekonnen entitled with **Characterization of Honey Production** and **Marketing systems, Challenges and Opportunities in Ada Berga district, West Shoa Zone, Oromia, Ethiopia.** We here by certify that, the thesis is accepted for fulfilling the requirements for the award of the degree of **Master of Science in Agriculture (Apiculture).**

Board of Examiners

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DECLIRATION

This is to certify that this thesis entitled "**Characterization of Honey Production and Marketing Systems, Challenges and Opportunities in Ada Berga District, Oromia Region, Ethiopia"** submitted in partial fulfillment of the requirements for the award of the degree of Master of Science in **Apiculture** to the Graduate Program of College of Agriculture and Environmental Sciences, Bahir Dar University **by Etenesh Mekonen** (**ID.** NO.BDU0702194PR is an authentic work carried out by her under our guidance. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of our knowledge and belief.

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CHARACTERIZATION OF HONEY PRODUCTION AND MARKETING SYSTEMS, CHALLENGES AND OPPORTUNITIES, IN ADA BERGA DISTRICT, OROMIA REGION, ETHIOPIA

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ABSTRACT

The study was designed to characterize honey production and marketing systems, challenges and opportunities in Ada Berga district, Oromia region in 2015/16. Four peasant associations (PAs), namely, sire berga, gatira nabe, haro boro and sambaro sago of Ada Berga were selected based on variations in agro-ecology (high land, mid land and low land). A total of 160 respondents with differing number from each PA were selected randomly. The selected respondents were interviewed using pre-tested semi-structured questionnaire and single multiple – subject formal survey method was used to collect the data. The data collected was analyzed using descriptive statistics using Statistical Package for the Social Sciences (SPSS) version 23. Furthermore, measurements of honey production from 10 hives each of the different types studied (frame, transitional and traditional hives) were evaluated. The results of the household survey showed that the majority of the hives owned by the bee keepers was traditional, followed by modern and lastly transitional bee hives. Beekeepers harvest an average of honey from traditional 4 ±1.36 in the high land, 4.17±1.1in the mid land, 8.7±3.04in the low land, from transitional 11.8±2.3in the high land, 14.5±1.5 in the mid land, 15.9 ±4.04in the low land plus from frame hive 15.9 ±2.8 in the highland, 20.8±4.2in the mid land and 21±4.5in the low land kg/hive/year. The major actors in the honey value chain in the study area are tej producers and customers. From the result of this study, the major challenges of honey production and marketing systems were application of herbicides and pesticides , bee eat birds, lack of market center at village and district town, and the minor challenges were pests, shortage of bee forage lack of market information, low price and price fluctuation during harvesting period. The opportunities in the study area were:-the existence of honey bee colony, extension service, the help of Holeta bee research center and non-government projects and indigenous knowledge. The honey yield is high both in mid land and low land agro ecology from frame and transitional bee hive in the study area. Hence farmers in the mid land and low land can participate both in frame and transitional hives.

Key words: Agro ecology, Beekeepers, Honeybee colony, Honey production, marketing system; Measuring,

ABBREVIATIONS

BC	Before Christ
DA	Development Agent
ETB	Ethiopian Birr
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
GO	Governmental Organization
HBRC	Holleta Bee Research Center
KTB	Kenya Top Bar
KG	Kilogram
KM	Kilometer
LIVES	Livestock and Irrigation Value Chains For Ethiopian small holders
MBH	Mud -Block Hive
MoA	Ministry of Agriculture
NGO	Non-Governmental Organization
OARI	Oromia Agricultural Research Institute
PA	peasant association
PASDEP	Plan for Accelerated and sustainable Development to End Poverty
SPSS	Statistical Package for Social Sciences.
SD	Standard Deviation
TTBH	Tanzania Top Bar Hive
US	United State

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Chapter1: INTRODUCTION

1.1.Background and Justification

Beekeeping or apiculture entails the rearing or keeping of bees with the aim of exploiting its products (such as honey, pollen grain, propolis, and brood) (Onwumere, *et al*., 2012). Whereas, Belets Gebremich and Berhanu Gebremedhin (2014) reported that apiculture is a promising off farm enterprise, which directly and indirectly contributes to smallholders' in come in particular and nation's economy in general. In addition, Takele Gina (2014) report s indicated that Ethiopia is one of the countries in the continent that has the largest honey bee population and owns a big honey production potential in its varied ecological and climatic zones. Specifically, Ethiopia is the largest and leading honey producer in Africa and tenth largest honey producer in the world.

Unlike many other commodities such as crop and livestock, honey products generate multiple market opportunities, and are also nutritious foods. In addition, the production process is not in competition with any other form of agriculture and it can be integrated positively (Aravindakshan *et al.,* 2011; Gallmann & Thomas, 2012).The same to that, honey production is also considered as a natural resource conserving and environmentally friendly activity Gidey Yirga and Mekonen Teferi (2010) through its plant pollination services. Thus, it should be one of the most important intervention areas for sustainable development among poor countries like Ethiopia (Gibbon, 2001). Recently, its contributions in poverty reduction, sustainable development and natural resources conservation activities have been well recognized and emphasized by the government of Ethiopia and non-governmental organizations (NGOs). Consequently, the government has identified beekeeping sub-sector as one of the engines of economic growth with its potential in poverty reduction and conservation.

Based on the level of technological advancements, three types of beehives (traditional, intermediate and frame hives) are used for honey production in Ethiopia. Despite the long beekeeping tradition in Ethiopia, the highest bee density, being the leading honey producer and one of the largest beeswax exporting countries in Africa, the share of the sub-sector to the Gross Domestic Product (GDP) of the country has never been commensurate with the huge resources and the country's potential for beekeeping.

Productivity has always been low, leading to higher domestic hive products utilization and relatively low export earnings. With this, even if efforts are still on-going, most of the on-station based adaptive research works which were carried out for the last few decades couldn't improve hive productivity and honey production so far. This, we believe, is because of the various honey production constraints with varied consequences. Thus, as conditions are different from place to place and even from beekeeper to beekeeper, in order to find out exactly what is going on and identify the key factors and measures, understanding the prevailing conditions in each of the beekeeping areas of the country shall be considered as an important activity. However, even if Ada Berga district is believed to have diversified vegetation, cultivated crops composition, and considered as beekeeping potential, a detailed and comprehensive research data on honey production systems, challenges and opportunities in the area is not available so far (Workeneh Abebe, 2011) . Furthermore, the information on current honey marketing systems in Ethiopia in general and Ada berga district in particular is lacking for its details. We, thus, strongly believe that availing such important information for the study area will be a PLUS to our database and development plan of the district. Therefore, this study is conducted to give an insight into the honey production potential, marketing systems, constraints and opportunities in Ada berga district, Oromia region, Ethiopia.

1.2.Statement of the Problem

Beekeeping by its nature doesn't need huge investment (financial asset), large size of land and complicated technical knowledge. Further, the outcomes of beekeeping (income, material goods, wellbeing and satisfaction) are real (Nicola, 2009). Beekeeping strengths and supports the rural community livelihoods to become less vulnerable to different shocks and avert risks. However, the individual poor beekeeping farmers in particular and the country in general still could not harvest honey to the required amount which in turn income from this sector to the producer, trader and the country is generally low in honey. Of the total honey production in Ethiopia, about 41.22% was used for household consumption, about 54.68% for Sale, about 0.34% used as payment for wage in kind and the rest (3.75%) used for other Purposes (CSA, 2015).

Haftu Kebede *et al*.(2015) reported that even if, the government of Ethiopia has given due attention to apiculture development as a means of poverty reduction and national exports diversification strategies research couldn't address all possible aspects and areas to

describe and document apiculture resources and associated constraints for proper intervention and utilization (Chala Kinati *et al.*,2013). Furthermore, beekeepers in the study area and all areas of the country in general are considered to be rich in indigenous knowledge. In general, we believe that there are different honey production and marketing challenges which couldn't enable the beekeepers to maximize beekeeping outputs. This work, we believe, therefore, has tried to magnify and suggest possible solutions against production and marketing constraints and identified some major challenges that are obstacles to product maximization in the study area.

1.3.General Objective

The overall objective of the study was to assess the honey production and marketing systems, to analyze the challenges and opportunities of honey production and marketing systems in Ada Berga district.

1.3.1.Specific objectives

- To characterize the honey production systems in the study area
- To characterize honey marketing systems in the study area.
- To identify major challenges and opportunities of honey production and marketing systems in the study area.

1.3.2.Research questions

1. What type of honey production system present in the study area?
2. What type of honey marketing system present in the study area?
3. What are the major challenges and opportunities of the honey production system in the study area?
4. What are the challenges and opportunities that affect honey marketing in the study area?
5. What possible suggestions could be drawn as a solution for honey production and marketing challenges in the study area?

Chapter 2: LITERATURE REVIEW

2.1. Origin and Evolution of Bees and Beekeeping

Bees likely have evolved from wasp like ancestors, contemporaneously with the angiosperm plants towards the end of cretaceous period, 60 to 100 million years ago (Martin, 1976).The wasp ancestor was, probably a sphecid, with mouthparts capable of ingesting nectar, which began collecting pollen to feed to their brood instead of killing prey. While bees have diverged from wasps in many characteristics Michener (1974) the most distinctive morphological differences involve specializations for pollen collection. Moreover, according to Dietz (1986) the present bee fauna probably originated more than 70 million years ago.

Bees (*Apoidea*) are a super family in the order Hymenoptera. Currently, eleven families of bees (in about 1000 genus, sub genus combined with sub genera) are generally recognized, only some of which are identified by derived traits setting them apart from other bee families. As reported by Roubik (1989) a total of approximately 600 generic groups and an estimated 20,000 living species of bees are believed to reside in the world where the majority of them are 'solitary' while the minorities are social including the bumble bees (*Bombidae*), stingless bees (*Meliponidae*) and few species of social honey bees (*Apidae*) (Smith,1960). However, very few honey bee colonies are kept in hives by beekeepers. The *Bombidae* are found mainly in temperate climates. Their nests are very small, often in the ground and are of no commercial importance except as pollinators of certain plants. The *Meliponidae*, or stingless bees, occur throughout the tropical regions of the world. In addition, their nesting places are pots in the ground, hollow trees or small cavities in walls and underside of branches. As reported by FAO, 1986; Crane (1990) the family *Apidae*, to which the honeybee belongs, is indigenous only to Europe, Africa and Asia

2.2. Species and Races of Honey Bees

Apis reniformis, *Apiscerana*, *Apisceranaindica*, *Apisdorsata*, *Apisdorsatabinghami*, *Apisflorea*, *Apislaboriosa*, *Apismellifera* and *Apisvechti* are the 9 species of honeybees which have been recognized since the late 1700s (Roubik, 1989). Among these,

Apiscerana/*indica*, *Apisdorsata*, *Apisflorea* and *Apismellifera* are the major honeybee species considered as world's economic important species.

Race in honeybees is a result of natural selection and honeybees have been adapted to different geographical areas of the world for many years without the interference of mankind. In so doing, there has been an environmental effect on the anatomy and physiology of honeybees leading to differentiations.

African and European honeybees, even though were from the same species, are differing in behavior, production and on some morphologically important variables. Hence, quite a large number of subspecies (races) of honeybees are found in the world today and about 10 geographical races of honey bees found in Africa.

2.3. Important Races of Honey Bees

Bees that produce enough honey to be worth harvesting belong to the two sub families of *Apidae*, *Apinae* (honeybees) and *Meliponinae* (stingless bees). *Apinae* has only one genus, *Apis*, and about nine species of which *Apismellifera* is of much greater economic importance than any others. *Apismellifera* ('honey- making bee') is one of the most successful species in animal kingdom. It became more adapted to wide range of environmental conditions to greater extents. Although as Ruttner (1986) reported this is the one which is able to survive in semi desert tropical regions as well as in cold-temperate zones except in the severe cold areas of the Polar Regions (Adjare, 1990). In addition, the races and strains of *Apismellifera* are over riding world importance in beekeeping, and are the basis of world's beekeeping industry. These bees are native to Africa and Europe. However, they have also been introduced in to almost the whole of the New World (the Americans, Australia, New Zealand and Pacific Islands) since 1500 where there were no native honeybees (Crane, 1976). European *Apismellifera* is the first studied bee, and it still receives by far the most attention.

2.4. Overview of Beekeeping in Ethiopia

In Ethiopia, beekeeping has been a tradition since long before other farming systems (Gezahegne Tadesse, 1996). Even though it is one of the important and oldest farming activities in the country, there are no available records, which confirm when and where beekeeping was first started. Generally, as reported by Benjamin and McCallum

(2008) the use of honey as food and medicine and that of wax for candle lighting in churches has a long history in Ethiopia (Ayalew Kassaye, 2006, Nuru Adgaba, 1999).

However, the Hieroglyphs of ancient Egypt refer to Abyssinia (ancient name of Ethiopia), as source of honey and beeswax and Abyssinia has been known for its beeswax export to Egypt for centuries when other items were not exported (Gezahegne Taddese, 2001).In similar way Fichtl and Admasu Adi (1994), Gezahegne Tadesse (2001b) has been also suggested that no country in the world may have ancient beekeeping as Ethiopia

2.5. Geographical Distributions of Ethiopian Honey Bees

The topography of Ethiopia is complex and the altitude varies from the lowest point below 126 m to the highest point 4620 meters above sea level (Amssalu Bezabeh *et al.,* 2001). And also, these variable agro ecological zones lead to huge diversification in species of fauna and flora. Moreover, its forests and woodlands contain diverse plant species that provide high amount of nectar and pollen to foraging bees (Girma Deffar, 1998).

The country is not only agro-climatically diverse, but also a center of diversity for different species of plant and animal resources including honeybee races. The geographical races of honeybees found in the country, have been studied by different scientists and the existence of different geographical races was reported. Generally, most of the reports were not supportive of each other. According to Amssalu Bezabeh *et al*. (2004) the multivariate analysis of the morphometric characters revealed the existence of five statistically discrete populations occupying different ecologies in the country: *A.m. jemenitica*, in the northwest and eastern arid and semiarid lowlands, *A.m. scutellata* in the west, south and southwest humid midlands, *A.m. bandansii*, in the central moist highlands, *A.m.monticola* in the northern mountainous highlands and "*Woyi-gambela*" in south western semiarid to sub humid lowland parts of the country.

Research by Marina *et al.* (2011) brought that, a controversial idea about the different honey bee sub species of Ethiopia. Accordingly, they described a new subspecies, *Apis mellifera simensis*, on the basis of morphometric analyses. These authors also explained that Ethiopian bees are clearly distinct and statistically separable from honeybees belonging to neighboring subspecies in eastern Africa. Moreover, considerable variation of morphological characters in relation to altitude is present in the samples under analysis, but there are no statistically separable subgroups within this population and concluded that

there is no indication for the presence of more than one subspecies of honey bee in Ethiopia. This indicated that there should be additional efforts to characterize in details and delineate the geographical distribution of the bee races.

In Oromia region, three geographical races of honeybees (*A.m.jemenitica*, *A.m. scutellata* and *A.m. woyi Gambela*) are reported to exist in different ecological zones of the region (Amssalu Bezabeh, 2002). Hence among these, *A.m. scutellata* is widely distributed in the region. Behaviorally, the migratory tendency of scutellata is very low.

2.6. Honey Production Systems in Ethiopia

Honey hunting and beekeeping have been practiced in the country for the exploitation of honey. As reported by, Tessega Belie (2009) in places where wild colonies of bees living in hollow trees and caves are found, honey hunting is still a common practice in Ethiopia. In addition, Ayalew Kassaye (2008) reported that currently in Ethiopia, beekeeping is practiced in three types of production systems namely; traditional, transitional and frame beehive beekeeping.

2.6.1. Honey hunting

The earliest honey hunting evidence comes from rock paintings, equipment used and anthropological studies obtained first in Spain, which is dated back to 30,000-10,000 B.C. This practice (honey hunting), as a beekeeping system, is also widely practiced by some tribes of the south and southwest Ethiopia (like Messenger tribe in Gambela).

2.6.2. Traditional beekeeping

Traditional beekeeping is the oldest and the richest practice, which has been carried out by the people for thousands of years in Ethiopia. This beekeeping practice is extensive and closely tied to swarm management: beehives are hung up in trees to catch swarms and are then transferred and placed in the backyards with some kinds of hive sheds that protects them from the hot temperature and rain.

Traditional beehives (30-40 cm across and 1 m long) are crafted by creating a tube shaped structure using branches, straw, cow dung and clay. But, sometimes hives can be made from soft logs of a cactus tree (Gallmann and Thomas, 2012). Hence, several million bee

colonies are managed in these kinds of hives and traditional beekeeping methods in almost all parts of the country (Fichtl and Admasu Adi, 1994).

As reported by, Beyene Tadesse and David (2007) under Ethiopian farmers' management condition, the average amount of crude honey produced from a traditional beehive is estimated to be 8 to 15 kg per harvest/beehive/year in which about 8-10% of its weight is beeswax. However, this harvest is achieved with minimal cost and labor, which is valuable to people living a marginal existence (Tessega Belie, 2009).

This beekeeping practice may differ from place to place and beekeeper to beekeeper based on the resources and knowledge in the area. Accordingly, two types of traditional beekeeping practices are found in the country (forest beekeeping and backyard beekeeping). In some places, especially in the western and southern parts of the country, forest beekeeping is widely practiced by hanging a number of traditional beehives on the trees.

In the other most parts of the country, backyard beekeeping with relatively better management is the common and dominant type of beekeeping (Nuru Adgaba, 2002; Gallmann and Thomas, 2012). However, traditional beehives in this system have their own disadvantages on colony management and honey harvesting activities including: difficulty in colony inspection for brood diseases, difficult to work with open hives in the night, not appropriate for artificial queen rearing, higher chance for a number of bees and a queen to be killed during operations, very difficult yield and behavior targeting selection. Furthermore, colony feeding during times of food shortage is not easy and appropriate, difficult to judge ripeness of honey before harvesting, low quality honey harvest, brood, nectar and pollen storing combs will be destroyed during harvesting.

2.6.3. Transitional beekeeping

Transitional system, which has been speculated to be started in Ethiopia since 1976, is a type of beekeeping which is intermediate between traditional and modern beekeeping. Transitional (intermediate) beekeeping practice has different advantages over traditional system. These include: hives can be opened easily and quickly, the bees are guided to building parallel and unattached combs following individual top bars, top bars are easily removable and this enables beekeepers to work fast, top bars are also easier to construct,

honeycombs can be removed from the hive for harvesting without disturbing combs containing broods, beehives can be suspended with wires or ropes and this gives protection against pests.

However, transitional beekeeping has its own disadvantages such as top bar hives are relatively more expensive than traditional beehives, and combs suspended from the top bars are more apt to break off (HBRC, 2004). Thus, as reported by, HBRC (1997) the types of beehives used more frequently in this system are the Kenyan top-bar hives (KTBH), Tanzania top-bar hives (TTBH) and Mud- block hives (MBH). Among these, KTBH is widely known and commonly used in many parts of the country

Generally, a top-bar hive is a single story long box with slopping sidewalls inward toward the bottom (forming an angle of 115^{o} with the floor) and covered with top bars of fixed width, 32 mm for east African honeybees (Segeren, 1995). Currently, intermediate or transitional beehives that are either the Kenyan top bar hives or the locally made "chefeka" hives. According to Workneh Abebe *et al.* (2008) the honeybees have accepted the Chefeka hive made from locally available materials. According to the CSA (215/16) the current distribution of transitional bee hives in Ethiopia 70,753 and 1.2%.

2.6.4. Frame hive beekeeping

The main purpose of frame hive beekeeping method is to obtain the maximum honey crop, season after season, without harming bees (Nicola, 2002). Accordingly, it uses different types of frame hives (Zander and Langstroth hives being common in the country, Dadant, Modified Zander, and foam hives are also found). However, these hives basically differ in the number and size of frames. Generally, frame hive consists of a precisely constructed rectangular boxes (hive bodies) superimposed one above the other in a tier. Similarly the number of boxes (suppers used) varies with season, population size and activities of bees.

As reported by, HBRC (1997) these box hives have an advantage over the others in the volume and quality of honey harvested (averagely 15-20 kg/year and in potential areas up to 50-60 kg harvested). Moreover, the hives allows swarm control through supering and colony management, it is easy to transport and allows the use of higher level technologies. However, equipment in this beekeeping system are relatively expensive, require skilled manpower, very less wax production only 1-2% of the honey yield Gezahegne Tadesse (2001) and needs very specific precaution.

2.7. Economic Importance of Beekeeping in Ethiopia

Beekeeping has been and still plays a significant role in the national economy of the country as well as for the subsistence smallholder farmers. In addition the contribution of bees and hive products, though difficult to assess, is probably one of the most important small-scale income generating activities for hundred thousands of farmer beekeepers. In this case, we consider that beekeeping has many advantages that help farmer beekeepers to improve their wellbeing.

Even if, it has been scarce information to generalize the economic benefits of beekeeping in Ethiopia due to not uniform data presentations from different bodies and lack of concrete knowledge to estimate properly GideyYirga and Mekonen Teferi (2010) it has been believed and understood that beekeeping has a great role in supporting beekeepers' life and allows lots of business people to establish their life. These all and others have been because of the following socio-economic impacts of beekeeping, main hive products and services from honeybees explained below:

2.7.1. Honey production

Honey, the natural product of honeybees, has many times been described as man's ever sweetest food. Consequently, as honey contains simple sugars that are ready for assimilation upon reaching intestine, it is an excellent energy source. Furthermore, as reported by, HBRC (1997) it contains more than 180 elements and it has several uses. In other ways, of the total honey production in Ethiopia, about 41.22% was used for household consumption, about 54.68% for Sale, about 0.34% used as payment for wage in kind and the rest (3.75%) used for other Purposes (CSA, 2015). Despite, Ethiopia has substantial potential for beekeeping development and the MoARD has apiculture as one of the priority commodities targeting the local and export markets (Johannes Agonafir, 2005This makes Ethiopia leading in Africa and ninth in the world in honey production.

2.7.2. Beeswax production

We know that bees wax is the place where the queen bees produce their eggs and develop them all cycles in it. According to Sanford, M.T.; Dietz, A. (1976) the wax is formed by worker bees, which secrete it from eight wax-producing mirror glands on the inner sides of the sternites (the ventral shield or plate of each segment of the body) on abdominal

segments 4 to 7. In addition, the sizes of these wax glands depend on the age of the worker, and after many daily flights, these glands begin to gradually atrophy. As informed by Crane, E (1990) candles of beeswax were used already by the ancient Egyptians, ancient Greece, and Rome and in old China.

2.7.3. Crop pollination

Agriculture is the main sector providing income, employment and food for about 85% of the population in Ethiopia residing in the rural areas of the country. Economic development of the nation, therefore, depends on the prosperity and economic growth of the rural areas, which depends directly or indirectly on crop productivity through tremendously neglected pollination services from insects including honeybees. In addition,most of the cultivated crops are cross-pollinated, which are mostly visited by the honeybees for the collection of pollen, nectar or both where on the way provide their most valuable pollination services. However, pollination service provided by the honeybees is considered as a fortune by-product as pollinators of over 100 cultivated crops. In this regard, honey production, which is always so closely associated with honeybees in the eyes of laymen, pastels into insignificant when compared to the value of the pollination services provided by this insect. So, it is interesting sometimes to note the value of honeybees as pollinators from the figures for the value of honeybees to the agricultural economy. To take an example, in 1987, only in the United States of America, honeybee's pollination Value was estimated to be about US$ 9.3 billion. This would be important to understand how pollination services of honeybees are supporting lives of millions of people in Ethiopia as well. Consequently, in Ethiopia, an experiment was conducted to determine the effect of pollination on Niger (Guizotia abyssinica) and the result showed that honeybees increased the seed yield of Niger by about 43% (Admasu and Nuru, 2000) and Onion (Allume Cepa) by two fold (Admasu et al, 2008).

2.7.4. Selling of honey bee colonies

The most obvious method for the beginner to start beekeeping is to purchase an established colony from the existing beekeeper in its available hives. In bee colony shortage areas, the selling of bee colonies is becoming a new business venture to generate additional income to the beekeepers. Similarly, multiplications of colony through queen

rearing can be one of the areas of income generation or mean of modification of income. Multiplication and selling colonies can be also area of specialization.

2.8. Marketing Systems

Beekeepers, honey and beeswax collectors, retailers, tej brewers, processors and exporters are identified to be the key actors in the value chain and/or marketing system of the honey sub-sector. Three principal channels (the tej brewery, honey processing and exporting and beeswax) were identified in the value chain. These channels are complex and found to be interconnected which is explaining the absence of organized marketing channels/systems and lack of formal linkages among the actors in Ethiopia.

Honey processors' and exporters' channels, among the value chain actors, starts from beekeepers and goes through the local agents and/or honey marketing cooperatives, which supply the honey directly to the processing plants after semi processing or as it is. Then after, processing plants will further refine the honey, pack into labeled containers to deliver for local markets (super markets, food groceries and big hotels) and very often to export markets (Beyene Tadesse and David, 2007). In this process, according to Nuru Adgaba (1999) as beekeepers are producing low quality products because of their handling and management, they are forced to sell locally to retailers and wholesale buyers at low prices.With this and inappropriate price settings by local traders and collectors, local beekeepers are believed to loose significant amount of income in which the marketing system still remains unstable. Furthermore, it is not a secret to observe, because of poor handling and inappropriate resource management; beekeepers by themselves are demanding large quantity of beeswax. This is one way or the other, a result of poor marketing system in collaboration with in sufficient extension services.

2.9. Beekeeping and the Environments

Naturally, honeybees have a high degree of adaptation to a wide range of environment, can switch to the available farming system easily, and do not contribute to land degradation and ecological imbalances. Thus, beekeeping is considered to be a major integral component in agriculture of developing countries through the production of much more than a food.

2.10. Major Challenges and Opportunities in Beekeeping

Ethiopia has enormous and untapped potential for promoting beekeeping; both for local use and for export purposes. Even if, the prevailing production constraints in the beekeeping sub sector vary depending on agro ecology, socio-economic conditions, cultural practices, climate (seasons of the year) and behavior of the bees Edessa Negera (2002) like any other livestock sector, beekeeping has been ceased by complicated constraints such as low quality products, lack of market information, absence of organized market channel, transportation problem, lack of government support in promoting market development, low involvement of private sectors, low and discouraging price settings in local markets, lack of appropriate technologies for collecting, processing, packing and storage (Gezahegne Tadesse, 2001).

In addition, 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 hive products' postharvest management, misuse of agrochemicals, honeybee disease, pests and predators, poor extension services, absence of coordination between research, extension and farmers, lack of policy application in apiculture, shortage of records and up-to- date information, and inadequate research institutions to address the problems were also identified potential constraints in the previous years (HBRC, 1997; Ayalew Kassaye, 2001; Edessa Negera, 2002).

On the other hand, as an opportunity to develop the beekeeping sub-sector, facilitate market development and market oriented agricultural growth, some important policy, proclamations and strategic instruments (like Agriculture and Rural Development policy, honeybee resource use and protection proclamation, pesticides and agrochemicals use proclamation, Agriculture lead Industrial Development strategy, National Input and Output Marketing strategy, Development Corridor and Plan for Accelerated and Sustainable Development to Eradicate Poverty or PASDEP,etc) have been put in place (Bezabih Emana, 2010).

For instance, as it has been indicated in the second growth and transformation plan GTP II (2015/16 -2019/20) the average honey yield per harvest from frame hives is also planned to increase yield from 20 kg in 2014/15 to 30 kg by 2019/20. In the same way, the total

production of honey is projected to increase from 60.7 thousand tons in 2014/15 to 123.9 thousand and total production of wax is projected to increase from 5.7 thousand tons in 2014/15 to 8.6 thousand tons by the end of the plan period. Therefore, these policies, proclamations and strategies are targeted to promote productivity through resource protection, encourage market oriented production and marketing of agricultural products according to their niches and support the struggle towards poverty alleviation. Furthermore, existence and abundance of honeybee, availability of potential flowering plants, and ample sources of water for bees except in drought prone area, traditional knowledge of beekeepers' experience and practices and socio-economic value of honey are also serving as an opportunity for the development of beekeeping in the country. Thus it has been believed that all the constraints and opportunities may not be equally valued and understood among the beekeepers and value chain actors in different parts of the country due to various reasons. Therefore, continuous assessment and characterization of different localities and beekeepers shall be considered as a major task that concerned bodies should practice.

Chapter 3: MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in Ada Berga district which is located in Oromia National Regional State, West Shoa administrative zone at about 88 Kms West of Addis Ababa and bordered by Walmara in the South , Ejerie in the Southwest, Meta Robi in the West, and Mugher River in the North and East which separates the district from North Shewa zone. The altitude extends from 1,400 to 3,500 meters above sea level. The average rain fall ranges from 918 to 1,450 mm and its agro ecology is represented by highland (29%), midland (37%) and lowland (34%). The total population of this district is estimated to be 124,504 (62,416 males and 62,088 females) with an estimated population density of 136 people per square kilometer in which 15.11% (18,812.55) of the total population are urban dwellers. The district has an estimated area of 955 square kilometers. The livestock population in the study district is estimated to be: cattle = 198599; Sheep = 59,430 Goat = 31,880 Equines = 28,158; Poultry= 67437. A total of 18,092 beekeepers are also estimated to own 18,471 honeybee colonies (14,401 in traditional hives, 3,047 in transitional and 2,085 in improved box hives) (Ada Berga Livestock Office, unpublished data).

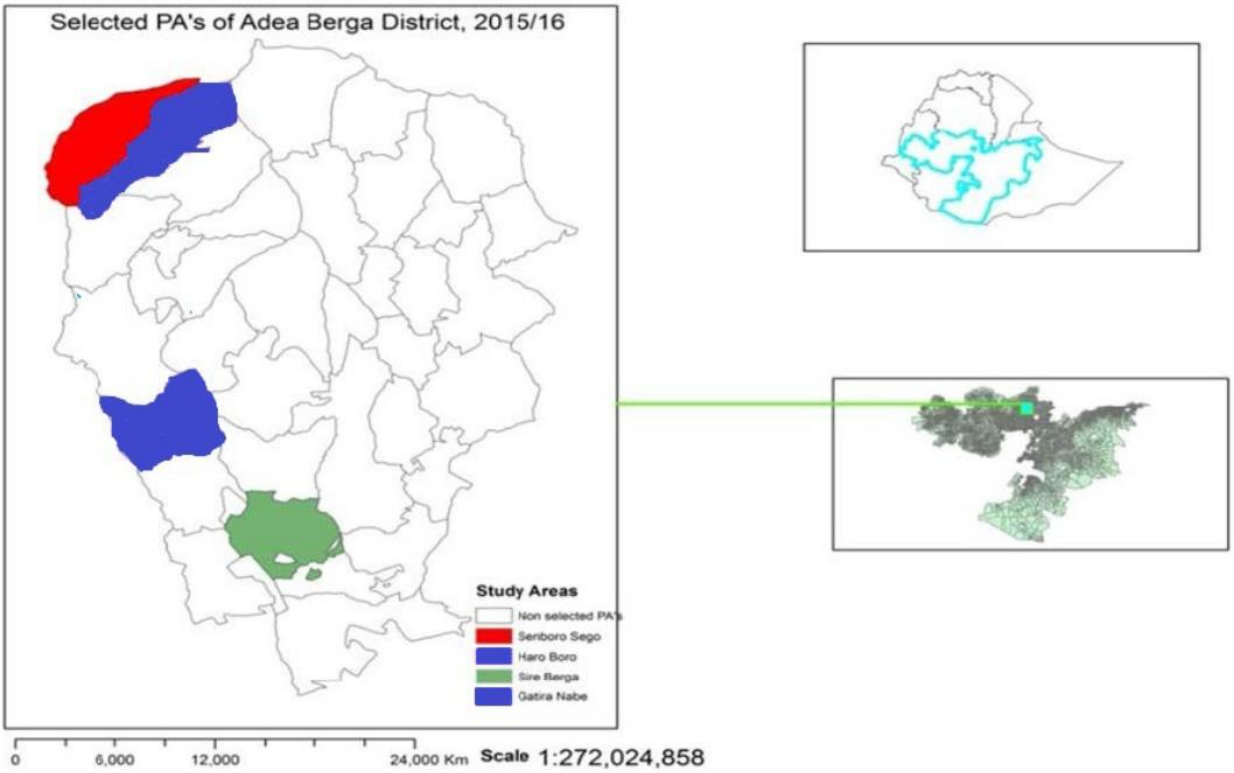

Figure 3.1: Map of study area

3.2. Survey Design and Sampling Techniques

For this study, the district was stratified into three using elevation as a criteria and it is generally believed that and revealed in many studies that farming systems, mode of life and many more characteristics vary across altitude zones (Cochran, 1973). The three altitude strata were high land (2300-3300) mid land (1500-2300) and lowland (800-1500) (Fikre Girma *et al, 2015).* Ada Berga district has 36 peasant associations (PAs, lowest Administrative units) and these PAs were divided into the three altitude groups. Four PAs (1 from highland, 2 from mid land and one PA from the lowland) were selected purposively for the study together with experts and development agents which was based on the potential of bee keeping. From these PAs, a total of 160 households who keep a minimum of 3 and above bee hives were selected randomly.

3.3. Method of Data Collection

Data essential to the study were collected from secondary sources, undertaking group discussions and formal survey and field observation.

3.3.1. Secondary data

The secondary data necessary for the investigation were collected from organizations and PA administrations.

3.3.2. Focus group discussions

Focus group discussions were conducted in the study area with purposively selected community representatives such as: - elders are having rich indigenous knowledge in beekeeping, PA leaders, DAs, bee experts and women representatives. In order to gain a greater insight into the topics during the formal survey and to validate or check the data collected.

Each of the focus group discussion consisted of 8 to 15 individuals and 3 group discussions were undertaken in the study area (one in each altitude zone).

3.3.3. Formal survey

A formal survey was conducted using structured questionnaire, with open-ended and closed-ended questionnaires with the help of trained enumerators. The survey considered the following major issues.

House hold characteristic: sex, age, households, religion, occupation, and education level.

Beekeeping production systems: the present number of hives owned, type of hives used, honey flow and years of experience in beekeeping.

Potential, challenges and opportunities of beekeeping in the area: information on place of keeping hives (site), harvesting time, dearth period and amount of honey harvested, honey storage facilities, honey selling situation ,potential honeybee plants and flowering time, poisonous plants, water resources availability, honeybee pests and predators, herbicides, insecticides and other chemicals applications have been collected

3.4. Measurement Data Collection

Measurement of the honey yield was done in all representative PAs of the study area through harvesting and measuring of honey with individual beekeepers. In this study, honey productivity from frame, transitional and traditional hives owned by the beekeeping farmers were measured for about two months (the potential honey harvesting months in the study area). In this case, 10 honey bee colonies from each of the hive types and agro-ecologies of the study area were measured and honey production per colony was measured on farm gates in order to understand the potentials of the honey bee colonies and systems of beekeeping in Ada Berga district. Descriptive statistics such as means, standard deviation, frequency and percentages were used to analyze the measured data.

3.5. Data Analysis

All collected data were coded and organized for analysis using MS excel and the SPSS software. The statistical analysis used in the study varied depending on the type of variables and information required. Descriptive statistics such as means, standard deviation, frequency and percentages was used to analyze the quantitative data using SPSS version 23 software were mainly applied.

Chapter 4: RESULTS AND DISCUSSIONS

In the first part of the results, we have tried to summarize the demographic and social characteristics of the sample respondent households. Next to this sub title, this study addressed the main body of the topic. More specifically, under these subtitles, honey production systems and marketing, major challenges of honey production and marketing systems, major opportunities of honey production and market systems in the study area have been discussed.

4.1. Demographic and Socio-Economic Characteristics

The demographic characteristics beekeepers were summarized in terms of gender, marital status, age, education level, occupation and religion as follows and described in Table 4. 1.

4.1.1. Gender of the respondent

Out of the total respondents, about 18.1% in the high land, 54.4% in the mid land and 20% in the low land of were males, whereas 6.6% in the mid land and .6% in the low land were females (Table 4.1). In beekeeping women constitute the neglected group in study area. But, the women's share of beekeeping work (cleaning under the hive house, protect from birds and different animals) often exceeds that of men. Her husband's decide how to work it and its advantage. This may be due to the reduced involvement of the government and non -government in the study area not supporting wisely female house hold headed farmers through beekeeping activity. Consequently, in order to increase the women's motivation in the study area in honey production it is important to focus on women's training. This result is similar with the result of Haftu Kebede *et al*. (2015) which stated that most of the interviewee household heads were male (89%) and the rest were female headed households (11 %.).

4.1.2 Marital status of the respondent

Marital status of the sample respondents indicated that about 17.5 % in the high land, 61.3 % in the mid land and 18.8% in the low land was married. Whereas 0.6% in the high land, in mid land1.9% while in the low land was single respondents (Table 4. 1). This indication shows that beekeeping activities could be performed by every group of the community regardless of their marital status. Because of the work of keeping bees and control the enemies of the honey bee individually is difficult as the beekeepers respond. Therefore, the participation of single beekeepers is very small in the study area. This result is related with the study of Haftu Kebede and Gezu Tadese (2014) which indicated that, of the total households interviewed, 96.8% are married. In addition married households have always a chance to get training and other advantages than other peoples.

4.1.3. Age of the respondents

Of the sampled households, about 5.6 % in the high land, 10% in the mid land and 8.1% in the low land were under the age range of 15 to 30, whereas 38.1% in mid land and 7.5% both in the high land and low land were in the age range from 31 to 50 and 13.8% in the mid land, 5% in the low land and 4.4% in the high land were above 50 years old respectively (Table 4.1). In this study, the survey result showed that farmers in the most productive age were actively engaged in beekeeping activities. This indicates that in the study area the advantage of beekeeping is known as other agricultural activities such as crop cultivation and livestock husbandry. The result of this study is agreed with Haftu Kebede and Gezu Tadesse (2014) which stated that the majority age of the beekeepers in the study area ranges between 40 to 49 years (37.6%).

4.1.4. Religion of the respondents

With regard to religion, 81.3% and 18.34 % of the sampled beekeepers were Orthodox and Protestants; respectively (Table 4.1).There is no Muslim people in the study area.

4.1.5. Educational background of the respondents

In terms of educational back ground, about 8.1% ,28.1% and, 4.4% of the beekeepers in the high land, mid land, and lowland, respectively were within the grade level of 1-6, while 3.8% in the high land,10% in the mid land, and 2.5 % in the low land beekeepers

were within the grade level of 7-10 and 0.6% in the high land,1.8 % in the mid land and 1.3% in the low land , beekeepers were grade 11 and above whereas the remaining did not get any formal or informal education (Table 4.1). In this study, traditional beekeeping practices are based on informal opportunities from neighbors or relatives. Accordingly, illiterate beekeepers have low participation on improved beekeeping. Since, working with frame hive need specific technologies the beekeeper could be write and read what he/she trained by experts. Due to the fact that the majority of beekeepers sampled were illiterate, we suggest that there is a need of intensive training and encouragement in beekeeping on transitional and movable frame hives to move them to improved beekeeping systems. However, an individual's level of formal education doesn't matter for successful beekeeping as most of the beekeepers in this study area are illiterate. This result similar with the study of Chala Kinati *et al*. (2013) which stated that,34.4% of those interviewed beekeepers did not receive any formal or informal education; and also similar with the idea of Ginchor (2003) who noted that the insignificant role of level of education in the traditional beekeeping.

Table 4.1: A summary of gender, marital status, age, education and religions of respondents.

Variables	**Altitude**					
	High land		**Mid land**		**Low land**	
	F	**%**	**F**	**%**	**F**	**%**
Gender						
Male	29	18.1	87	54.4	32	20
Female	-	-	11	6.6	1	.6
Marital status						
Married	28	17.5	98	61.3	30	18.8
Single	1	.6	-	-	3	1.9
Age						
15-30	9	5.6	16	10	13	8.1
31-50	12	7.5	61	38.1	12	7.5
>50	8	4.4	22	13.8	8	5
Education						
Illiterate	9	5.6	35	21.9	22	13.8
Grade 1-6	13	8.1	45	28.1	7	4.4
Grade 7-10	6	3.8	16	10	4	2.5
Grade ≥ 11	1	.6	2	1.3	-	-
Occupation						
Farmer	29	17.5	98	61.9	33	20.6
Religious						
Orthodox	23	14.4	74	46.3	33	20.6
Protestant	6	3.8	24	15	-	-

F= frequency, % = percent

4.2. Honey Production System in the Study Area

Honey production is not a new activity in Ada Berga district, and also in the country. In this sub title, beekeeping production system, colony placement, bee flora condition and water availability, honey harvesting season, beekeeping potential and constraints, and honey marketing activities in the study area have been described. Generally, in the study area, there are three types of honey production (Traditional, Transitional and frame/modern bee hive production) systems. These systems are therefore explained as follows:

4.2.1. Traditional honey production system

In common sense, the traditional beekeeping system utilizes accessible, cheap and plentiful local materials for hive construction and related issues very easily. These hives are also constructed using the indigenous knowledge among the beekeepers (Figure 4.1). According to the survey result, the percent of honeybee colonies in traditional hives owned by sampled beekeepers were out 1256 hives 14.8%, 44.8% and 40.4% in the high land, mid land and low land, PAs, respectively (Table 4.2). Because of the presence of horticultural flowers and diversity of trees, in the low and mid land of the study area beekeepers have great number of colonies. This result also revealed that a total of 1,256 of the colonies owned by respondents are in traditional hives suggesting that it is the dominant beekeeping system in the study area. This is also due to construction of the hive doing not need accepted measurement and cost. This result agrees with the result of Haftu Kebede and Gezu Tadesse (2014) reported that 90.7% of beekeepers own traditional hive.

The productivity of the traditional beekeeping system in the study area based on the beekeepers estimate, honeybee colonies in the traditional hives have been found to produce honey a mean of4 ±1.36 in the high land, 4.17 ±1.1 in the mid land and 8.7 ±3.04 in the low land kg/hive/year. Small differences between agroecology's were due to supplementation of feeding and watering practices of honeybees during the dearth periods. Which were comparable with the result of Atsbaha Haile Mariam *et al. (*2015) in Tigray region which reported that the mean amounts of honey produced from traditional hive per annum in Kolla-temben, Medebezana and Raya-azebo was 11.95, 17.94 and 7.57, respectively. Here, differences in the productivity of the bee hives within the same

production system could be explained by the reason that different beekeepers do have different colony management practices.

Differences between localities and season were also suggested to bring the productivity differences among the traditional honeybee colonies. And more, when the season is dearth the beekeepers managed their bees with extra (feeding besso, shiro and etc).

Figure 4.1: Traditional honey production system in low land by Garedo Elemo

4.2.2. Transitional honey production system

According to the respondents, transitional beekeeping system has different advantages and disadvantages as well. They explained that the hive is very cheap and easy to construct than frame hives and needs some construction tools and locally available materials (Figure 4.2). Furthermore, individual honey or brood combs can be inspected without destruction when compared to traditional hives. In addition to that, when we compare it with frame hives, as a potential disadvantage, respondents have agreed that in this hive, as honey combs are harvested as a whole, honeybee colonies are forced to construct new honey combs again and again which is time and resource consuming. Therefore, this of course has negative impact on productivity of the colonies.

The study showed that the respondents in each of the representative sampled sites; have out of the total 296 hives 14.5%, 72% and 13.5% in the high land, in the mid land and in the low land transitional hive, respectively (Table 4.2). In addition to that, in terms of hive productivity, beekeepers explained that they have found a mean of 11.8± 2.3 in the high land, 14.5±1.5 in the mid land and 15.9±4.04 in the low land, kg/hive year honey with volume of honey ranging from 0kg/hive to 23 kg/hive year. However, honey bee colony absconds from the hive, about days after or do not work well. The most common causes of

absconding mentioned by the respondents were Poor harvesting system, attack of hive by badger and cold season .Due to this reason the majority of the beekeepers didn't harvest honey. Similarly, this could be due to the variations in seasonal management, especially transferring time, technique ,and follow ups after transferring do have great effect on adaptability of the colonies to the new hives, differences in vegetation prevailing conditions, agro ecologies and some other factors.

Figure 4.2: Transitional honey production system in high land by Diriba Biru

4.2.3. Frame/modern honey production system

In the study area, frame hives were introduced by different non-government organizations (NGOs) like World Vision and the government and its introduction was greater than the transitional hives. Consequently, the current survey shown that respondents from study area owned a total of 469 hives, 10.5% in the high land, 79.7% in the mid land and 9.8% in the low land honeybee colonies in frame hives (Table 4.2). In addition, it has been also clearly observed that beekeepers which were trained by Holeta Bee Research Center (HBRC), World Vision and LIVES project were more advantageous than others (Figure 4.3). Therefore, this could explain different aspects. First, these organizations were using the right training approach to teach and convince some beekeepers to be engaged in frame hive beekeeping because of detailed and practically implemented trainings. Second, even if the extension is exerting too much effort to train and convince beekeepers to drive them to improved beekeeping, the training package or the training methods or level of teaching skill were not according to the demanding beekeepers. As a result these both have been observed to be implicated in the productivity of the beekeepers using frame hives which ranged from 13– 29kg of honey/hive/year.

The productivity of the frame beekeeping system in the study area, the beekeepers have found a mean honey production of 15.9 ±2.8 in the high land, 20.8± 4.2in the mid land and 21 ±4.5 in the low land kg/hive year. This result was less than the result of Atsbaha Haile Mariam *et al*. (2015) in Tigray region which reported that the mean amount of honey produced from frame hive was 28.29kg per annum. This is may be the difference of management. Even if the honey yield from these hives is better than that of traditional hives, easy to inspect colonies, enables them to harvest better quality honey because of excluders, respondents have explained that not running cost, relatively the initial cost is high to purchase the hive and colony. In addition to that, as the beekeepers respond not only the price of hive is expensive, the source and means of transport also difficult in the study area. Thus, to solve the cost of frame hive and source with the interest of beekeepers in the study area, the government and other service body, should be introduced the machinery factory (work workshop) in the study area.

Figure4.3. Frame Honey Production System in mid land by Dhaba Tafa

Table 4.2: Honey production systems in the study area

Variables	Altitudes							
	High land		Mid land		Low land		Total hives	
	F	%	F	%	F	%	F	%
Traditional	187	14.8	563	44.8	506	40.4	1256	100
Transitional	42	14.5	215	72	39	13.5	296	100
Frame	49	10.5	374	79.7	46	9.8	469	100

F=frequency,%=Percent

4.3. Current Practices and Placement of Honeybee Colonies

Normally, the suitable apiary selection to keep bee colony, is far from different factors like the community, road, vehicle sound, machines, animals, is an important consideration for productive beekeeping. Accordingly, of the sampled households, 10.6 % in the high land, 26.9 % in the mid land and 14.4 % in the low land place their colonies at the backyards (Figure 4.4), 7.5% in the high land, and 26.9% in the mid land, and 6.3% in the lowland under the eaves of the house and about 7.5% inside the house in mid land agro- ecology. As the result shows most of the beekeepers kept their hives at back yard. This is may be simple for management and day to day service for beekeepers in the study area. However, not in consistent with the result reported by Tesfaye Kebede and Tesfaye Lema (2007) reported that about 97.6% of the respondents in Adami Tulu put their hives on a branch of tree and the rest at back yard. Furthermore, none of the interviewed beekeepers kept their colonies in the forest. In addition, all the respondent beekeepers have no separate apiary for traditional, transitional and frame hives they keep in the same place they have. According to respondents explanation from those hive places back yard is chosen than the others by producing honey in all agro-ecologies.

Regarding the beekeeping experience that interviewed beekeepers have, 41.9%more than 15 years, 33.1% 5 years, 18.8% 5-10 years and 6.3% more than 11 years of beekeeping experience in the study area as our data showed. This result could explain that people are actively engaged in beekeeping from an early age and as they have long time experience, beekeepers' experience and information delivered during data collection is dependable. Most of the respondents have confirmed that their children even at early ages are also engaged in beekeeping in helping parents. Based on this exposure, young people gradually move on to become independent beekeepers as soon as they obtain their own colonies. They continue accumulating experience by seeking technical information from corresponding beekeepers whenever required.

Figure 4.4: The placement of 3 types of honey production system in the mid land by Fiqadu Olika

Table 4.3: Placement of the hives in the different agro ecologies of the study area.

Variable	Altitude					
	High land		Mid land		Low land	
	F	%	F	%	F	%
Back yard	17	10.6	43	26.9	23	14.4
Under the eaves of the house	12	7.5	43	26.9	10	6.2
Inside the house	0	0	12	7.5	0	0
Total frequency	160					
Total %	100					

F=frequency, % = percent

4.3.1. Sources of honeybee colonies

Beekeeping as a business or activity need to have a honeybee colony to start with where beginners should have from parents, catching swarms or buys from beekeepers. According to beekeepers, the majority (12.5% in the high land, 29.4% in the mid land, and 6.9% in the low land agro ecology) of them started beekeeping with a colony obtained from swarm catching found in the environment which further indicates that the study area has a potential and is favorable for the bees to live. Whereas,7.5% in the high land, 20% in the mid land and 10.6% in the low land agro ecologies of the respondent beekeepers have started beekeeping with a colony given from parents as a gift, bought from other beekeepers and a colony obtained by other means (working with earlier beekeepers and

given for their services) (Table 4. 4). Respondents have also explained that if a person wants to start beekeeping, he/she only need to prepare an appropriate hive then they will have a bigger chance to catch a swarm which has been a common phenomenon in the study area. This result agrees with the result of Haftu Kebede and GezuT adesse (2015) reported that most respondents 60.3% replied that they have got their colonies by catching swarms and the rest from their parents and buying. From those results any one can conclude that catching swarm from the environment is the highest source of the honey bee colonies in the study area.

Table 4.4.Sources of honeybee colonies in the different altitude zones of the study area

Variables	Altitude					
	High land		Mid land		Low land	
	F	%	F	%	F	%
Caching swarm	20	12.5	47	29.4	11	6.9
Gift from parents	8	5	32	20	17	10.6
Buying	-	-	12	7.5	3	1.9
Others	1	.6	7	5	2	1.3
Total	29	18.1	98	61.3	33	20.7

F= frequency, % = percent

4.5. Peak Honey Production Period

Honey is harvested at the end of flowering time. In the study area there are two phase of honey harvesting period. The major and the most known to all beekeepers is November to December and the minor one is from April to June. Hence, the period of honey harvesting clearly shows that the supply follows the flowering pattern of the flora which results in peak supply of honey during specific period and dropping during the dry season during which the bee colonies require extra feed. Which was similar with the result of Tessega Belie (2009) in Burie district and Chala Kinati *et al.* (2013) in Goma district, time of peak honey harvesting is from November to December.

4.6. Honey Marketing and Storage Containers

4.6.1. Honey marketing

The study of honey marketing channel is intended to provide systematic knowledge of the flow of honey trading from its origin to the final. One of the aims of beekeepers is to produce honey and sell it. To buy and sell honey or to connect the participants there is a structure although beekeepers and traders of honey didn't use constantly the same structure. Ada Berga has no district level and village level market center to sell honey. The major actors in the honey value chain in the study area are tej producers and customers. Producers are mainly smallholder farmers who supply their honey to tej house, customers.

Customers are found in Inchini and Mugher town and go to beekeepers house randomly to buy honey. In the study area out of the total respondents about 17.5% of beekeepers used their honey for home consumption. 81.5% of beekeepers supply their honey for marketing; from the total 81.5 % of beekeepers 50.6% sell to tej house, 31.9% to customers. This result is similar with the result of Yetm work Gebremeskel (2015) which shows that about 82.7% of the farmers sell all their produce.

The price of honey in the study area as reported by the sample bee keepers is basically depends on color, quality, and source as request appears to remain relatively constant throughout the year. The color of honey in the study area was red yellow and somewhat white. The yellow color honey is most preferred than red. Yellow honey is mostly produced in the low land area. It is lowest during harvesting season of honey (80ETB/kg). Sometimes, the price rises in the months following the soon after harvesting season, of honey (110 ETB/kg). `

Table 4.5. The main buyers of honey in the study area

Market Participant	Honey producers	
	F	%
Home consumption	28	17.5
Tej producers	81	50.6
customers	51	31.9
Total	160	100

F= frequency, % = percent

4.6.2. Storage container

Beekeepers store and sell their honey in villages and town markets in whatever containers are available. The quality of honey is affected by the type of storage container. About 99.4% of beekeepers in the study area used traditional containers which are exactly not appropriate to store honey. Example, clay pot. Figure 4.5.This result agrees with Chala Kinati *et al*. (2013) in Goma district, who reported that the commonly used traditional storage containers by beekeepers are clay pot, and container made of gourd pot (‘*kill*’). Only 0.6% of beekeepers used in suitable materials example plastic materials, jerry can etc. There is no difference in response in all PAs in the study area in materials used between altitudes. The effect of traditional materials on the users/ customers, the honey dries in short period of time after harvested. The dry honey has low price and it need high volume to measure for selling. So to have good customer the beekeepers in the study area aimed at they are selling or used for home consumption, keep their honey in good place and material.

Figure 4.5.Traditional honey storage in the study area

Figure 4.6. Suitable materials for honey storage in the study area

4.7. Measuring of honey yield

According to the measuring data collected, we have confirmed that honey yield varied with hive types and agro-ecologies. As a result, they harvested an average honey yield kg/hive 3 ± 1.12 in the high land, 10 ± 1.05 in the mid land and 6.5±.67 in the low land from traditional, 7.6± 1.11 in the high land, 18.8 ± 3.11 in the mid land, and 12.8 ± .66 in the low land from transitional, and 14.9± 2.9 in the high land, 25 ± 1.92 in the mid land and 17.64 ± 2.07 in the low land from frame hive. In addition, we have understood that agro-ecology was also causing a significant difference ($P<0.05$) productivity of the colonies in terms of honey yield. Accordingly, low and mid land agro ecologies were higher in honey productivity (in the amount of honey harvested) than the high land. This result coupled with field observations, low and mid land agro-ecologies are most favorable for honey production in the study area. The mid land and the low land of the study area have opportunities such as diversity of horticultural crops, no cold weather condition for bees.

Table 4. 6 . Mean and standard deviation of the honey yield measuring in the three agro ecology.

Type of hive	Altitude					
	High Land		Mid land		Low land	
	Mean	SD	Mean	SD	Mean	SD
Traditional	3	1.12	10.8	1.52	6.5	0.67
Transitional	7.6	1.11	18.8	3.11	12.8	.66
Frame	14.9	2.9	25	1.92	17.64	2.07

SD=standard Deviation

4.8. Challenges and Opportunities of Honey Production and Marketing Systems

Generally, beekeepers in the study area and the country as well are challenged by several honey production and marketing constraints. Beekeepers have also understood that colony number in their respective area is decreasing from time to time. However, in order to utilize outputs from the beekeeping sub- sector, identifying and characterizing the existing challenges and looking for possible solutions shall take a significant priority in the area. Accordingly, respondent beekeepers have identified the following major challenges which they want to have immediate interventions. Off course, some opportunities have also been indicated.

4.8.1. Challenges

4.8.1.1.Honeybee pests and predators

Honeybees are exposed to a broad range of various environmental stressors, which can be having an impact to apiculture. Most beekeepers distinguished the problem of their bee colonies and the time at which this problem occurred. According to the respond of beekeepers, birds, ants, spiders, wax moth, mice, lizards, small hive beetles and honey badger were identified as the major honeybee pests and predators. The current data shows that 1.3% in the high land, 20% in the mid land and 6.3% in the low land of beekeepers in the study area reported the problem of pest and predators (Table 4.7). This result agree with the result of Firisa Woyessa and Dejene Alemu (2016) reported that 51.7% honey bee abscond by the reason of birds. The amount and problem of those pest and predators are not different with the variation of altitude. Beekeepers in the study area used different methods to control those pests and predators. Building strong fence and kill with the help of doges, to control honey badger. The bee eater birds as a predator of the honeybees and difficult to control have been identified as a serious problem (challenge) for beekeeping in the area. This bee eating bird is sitting on a nearby branch of a tree or a fence and catches the worker bees at the hive entrance. The beekeepers used different methods to control the birds. Such as keeping their apiary in the morning, remove the constant place of the bird if it is around home and destroying the nest of birds. To control wax moth from the hive, beekeepers in the study area clean the hive and its environment .These pests cover the comb and destroy bees in the hive (Figure 4.7). Ants, the most important annoying insect

has been disturbing the colony which has forced a lot of colonies to abscond and be aggressive.

To control the ant the beekeepers in the study area used such methods; - controlling overgrowths grass under hive stand and environment, dusting ash under the hive stand, finding the original house of ant and killing the queen of ant found in the hole, and covering the hive stand with plastic materials. Spiders cover through their webs on the ways of the bees is trapping the honeybees and prey on them. Beekeepers in the study area control spiders only by cleaning the hive mouth/entrance and its environment always in the morning or afternoon .These result is almost similar with the study of Workineh Abebe, (2011): beekeepers protect spiders by cleaning their hive. Smoking "qarabicho (Echinops kebericho Mesfin) also protects snakes from the apiary. The method which beekeepers used is effective and the action they used has no negative side on bee colony.

Figure 4.7.Wax moth on comb

4.8.1.2.Misuse of pesticides and herbicides

The use of different agro-chemicals or pesticides is an important and common practice in crop production to fight against most crop damaging pest populations and diseases to produce high quantity of food round the world. However, if they are not used properly (according to their prescription for time of application and dosage), they bring about very crucial damage to pollination fauna (the honeybees in our case), environment and human health. As a result, reduction in pollinating insect population, quantity and quality reduction in hive products and crop yield reduction are some of the associated risks encountered.

As a matter of fact, honeybees visit flowering plants in search of nectar, pollen or both and fly from one plant to another. In this process, the honeybees are foraging on flowering plants on which some agro-chemicals have been applied for different reasons. Moreover, indiscriminate use of pesticides and herbicides has negative effects on the environment and the life of all pollinating insects. Sometimes, the effects of these chemicals on human beings are observable from different points which have been understood also by the local beekeepers.

From the result, teff, wheat, pea, barley, maize and different horticultural crops were some of the most common crops grown by the farmers in the district whereby they need different agro-chemicals for the control of different plant pests and diseases. 2.5%, 14% and 4.4% of interviewed beekeepers themselves confirmed to use agro-chemicals for different purposes majorly for the control of weeds in their crops (Table 4.7).This observation (affected of honey bee colonies by agro-ecology ,due to the use of agro - chemicals on the crops) coupled with our results clearly could elucidate that the local farmers in the study area doesn't have any information of the risks of indiscriminate use of chemicals and/or do not know how to use the chemicals appropriately with minimum damages. We hope, responsible bodies could understand our explanations here so that appropriate intervention shall be in place both from the extension wing and decision makers.

As an option to minimize risks of chemical use on honeybees specifically and pollinating insects and the environment generally, we would like to suggest that extension and research wings should collaborate with local administration bodies in awareness creation among the local farmers including the beekeepers on appropriate use of chemicals only for targets crops. Moreover, some of the possible practical options which could be advised include use of chemicals before flowering, late evening and/or early morning application, appropriate preparation of the chemicals according to their dosage and time of application, closing hive entrance for 1 or 2 days and transporting colonies for very few days away from the chemical application area. In this case, respondent beekeepers have confirmed that even if they are applying the agro-chemicals in the early morning and late evening, the other crop farmers are applying the chemicals at any time of the day in general and around the mid-day in particular. We could, therefore, understand here that not only local crop farming farmers but also significant numbers of beekeeping farmers do not know the

importance of honeybees other than hive products production. We found, thus, awareness creation on the pollination services of honeybees and other pollinating insects which is enabling us to survive on earth is an immense important activity demanding urgent intervention. Furthermore, respondent beekeepers complained that even if the misuse of chemicals and its associated risks are well known phenomena in the study area at all levels; no satisfactory solution (educating both beekeepers and non -beekeeper farmers in the study area about advantage of honey bee colonies on pollination service, feed the colony during agro chemical application) has been put in place so far. The reasons to cause these risks are: - formation of the agrochemical is more advantageous in the sun than in the cloud time. Farmers which have no bee colony are no nous for bees. Thus, at this point, we suggest that all the stakeholders should participate and work together to discriminate misuse of agro-chemicals and encourage farmers to integrate the use of chemicals with beekeeping so that they could benefit from their business.

4.8.1.3.Honeybee diseases

As we know, honeybee diseases are causing a significant effect on the health status and wellbeing of the honeybees. Even if they couldn't identify the common name of the disease and which is, 9.4% in the high land and 11.2 % in the mid land and 5% in the low land areas of the respondent beekeepers have confirmed the presence of honeybee disease in their apiaries and can be detected once in a while (Table 4.7). As the beekeepers respond the sign of the disease such as bees fail to fly, crown on the ground in front of hive, we probably say that these disease called virus. Fortunately, the most important brood and adult bee diseases (like the American and European foul brood diseases and some major viral diseases) nominated as killers of a colony have not been identified in the country in general and in the study area in particular. To know and control the disease from the study area the government should take the measurements such as identifications of the disease, means of transmission, season of prevalence and by what method it controlled.

4.8.1.4.Colony absconding

As one of the major problems in beekeeping, colony absconding was identified by only about 0.6% in the high land 5% in the mid land and 1.9 % in the low land of respondent beekeepers (Table 4.7). In addition, they have explained that colony absconding is

happening at any time of the year regardless of the hive types because of continues colony disturbances from different factors in which pest infestation is the most common cause. This result is agree with the result of Firisa Woyessa and Dejene Alemu (2016) reported that The most common causes of absconding mentioned by the respondents were poor harvesting techniques (50.85%) and invasion of hives by badger, spiders, ants, birds, and monkeys with 97.6%, 61.7%, 51.7%, 48.3% and 38.3%. This was further explained that absconding has been a major problem in traditional hives because of the fact that the hives are not convenient for internal inspection and also in frame hives because of the lack of skill in frame hive colony management. Off course, this has been also a self-explanatory problem happening because the majority of the beekeepers are not inspecting their colonies frequently. This is also because; most local beekeepers believed that opening colonies in any time of the year will increase absconding which needs to be changed. As a suggestion beekeepers should have always follow their bee hives to know, the colony problem and control it from bee enemies. Seasonal management such as feeding in dearth period, follow after transferring, reducing the space/super, were essential for transitional and frame hives.

4.8.1.5.Shortage of bee forages

Like other living organisms, honeybees need adequate nectar and pollen to survive, reproduce and honey production. Moreover, as the presence of bee forages varied from place to place and all plants are not equally important for bees in supplying both nectar and pollen resources, it should be understood that honey plants are home for bees and provide basic nutritional requirements for the survival and reproduction of honeybees. However, currently, misuse of honey and pollen source plants in the environment through significant deforestation has brought about shortage of bee forages endangering life on earth in general and in the study area in particular.

In this case, even if only 2.5% in the high land and 4.4% in the midland of respondent beekeepers do understand shortage of bee forage is a problem in their respective localities, this problem has been pronounced to be a nationwide most important problem endangering the beekeeping sub sector (Table 4.7). However, very few beekeepers from each of the sampled (agro-ecology) explained that they are working on bee forage development around their apiaries.

Though honeybees support the human kind through their immense pollination services in various agricultural crops, the role of honeybees in this regard is less understood by the local community in particular and among the country's farming community at large. Thus, this indispensable service from the honeybees in our agricultural economy, we strongly suggest, should be pronounced to encourage farmers for sustainable use of plant resources and their pollinators.

4.8.1.6.Lack of hive products market infrastructure

It has been a clear phenomenon that lack of appropriate marketing infrastructure is now well developed not only in the study area but also in the country as well. In addition, the simultaneous emphasis given by the government and all stakeholders have been observed to be at its infant stage and hope will continue as a major bottleneck in this sector unless and otherwise appropriate interventions are going to be put in place.

According to respondent beekeepers and our observations at various levels, lack of appropriate hive products' marketing place, lack of market information, absence or lack of known market route or channel, buyer dependent price settings, lack or inappropriate functioning of marketing cooperatives, less awareness on post-harvest handling of their produce and so on have been identified as major constraints in the marketing system. 1.3% in the high land, 4.4% in the mid land and 3.1% in the low land of beekeepers respond the problem of honey market in the study area (Table 4.7). In this case, we have failed to access the channel where the produce from the study area is going. Off course, even if it has been explained that the majority of the local produce is going to local consumers and tej brewers, we generally failed to follow and characterize the value chain in the study area. At this point, we would like to suggest that exploitation of the potential in beekeeping not only in the study area but also in the country has to be organized through an appropriate marketing infrastructure and channel. Generally, the country is believed to be a leading honey producing country in the continent with plenty of opportunities in the future. However, establishment and development of appropriate marketing infrastructures should be practiced in order to enable the value chain actors access the produce and contribute to the national GDP through its export earnings.

Table 4.7. Identified major challenges with the honey production systems in the study area

Parameters	Altitude					
	High land		Mid land		Low land	
	F	%	F	%	F	%
Honeybee pests and predators	2	1.3	32	20	10	6.3
Misuse of pesticides and herbicides	4	2.5	23	14	7	4.4
Honey bee diseases	15	9.4	18	11.2	8	5
Colony absconding	1	.6	8	5	3	1.9
Lack of hive products market infrastructure	2	1.3	7	4.4	5	3.1
Shortage of bee forages	4	2.5	7	4.4		
Shortage of water	1	.6	3	1.9		
Total	29	18.2	98	60.3	33	20.7

F=frequency, %=Percent

4 .8.2. Opportunities

Even though different constraints have been described for their possible effects exerted on the beekeeping subsector, it has been an established fact that the country is endowed with different opportunities and immense potentials. Accordingly, some of the opportunities associated with the study area and described by the respondent beekeepers are presented below:

4.8.2.1.Availability of honeybee floral resources

As a matter of fact, the country at large and the study area in particular have been described as rich in floral resources (data from Adaberga Livestock Agency). The diverse agro-ecologies and topography has been identified as one of the most important beekeeping potential areas in the region because of its floral resources.

The availability of multipurpose trees and shrubs in the study area has been identified not only as major sources of pollen and nectar for honeybees but also provide different services to the community. Of course, the interdependency between honeybees and floral

resources also enables the reproduction, productivity and diversification of plants on earth. Very recently, establishment of apiaries near a forest, closure and religious areas is a common practice in the study area. That is, we believe, because of the fact that beekeeping farmers have understood the values of floral resources for increased honey production and survival rate of the honeybee colonies. Generally, identified honey bee forage species in the study area have been described and characterized in (Table 4.8)

Table 4.8. Bee flora found in the study area.

Local name (oromigna**)**	Scientific name no. of flowering plants	flowering times in a year	flowering period	nature of the plant (tree, shrub, herb)	3*,4*,5*	means prop agation	6*,7*	1*,2*
Eebicha	*Vernoniaspp*	1	Nov-Jan	shrub	5	seed	7	1
Bargamo	*Eucalptusspp*	1	Mar-May	tree	5	seed	6	1
Loomii		1	Not identified	shrub	4	seed	6	2
Raafuu/gom enzara/	*Brassica Spp*	1	July- Sept	shrub	3	seed	7	2
Hadaa	*Biden spp*	1	Sept –oct	herb	5	seed and vegetation	6	1
Suufi	*Helianthus annuus*	1	Oct – Nov	shrub	5	seed	7	1
Shumburaa	*Cicercertinum*	1	Nov-Dec	herb	3	seed	6	2
Guwayyaa	*Lathyrns sativa*	1	Nov-Dec	herb	3	seed	7	2
Boqqolloo	*Zea mays*	1	Sept-Oct	shrub	3	seed	7	2
Nuugii	*Guitozia abyssinica*	1	Nov-Dec	pulse	3	seed	7	1
Qorxobbii	*Plantagolanceolatum*	-	through out	grass	5	seed	6	2
Talba	*Linumvsitatissiumum*	1	Sept-oct	pulse	3	seed	7	2
Avokado	*Perseaamericana*	1	Sept -Dec	shrub	4	fruit	7	2
Papaya	*Papaya carica*	1	Sept -Nov	shrub	5	seed	7	2
Mango	*Mangifraindica*	1	Sept -Dec	tree	5	fruit	7	2
Laaftoo	*Acacia spp*	2	June &March	tree	5	seed	6	2
Gatama	*Schefflera abyssinica*	1		tree	3	seed	7	1
Ejersa	*Olea Africana*	1	March-may	Tree	3	seed	7	2

Bakkannisa	*Croton macrostachys*	1	Sep –Oct	tree	5	seed	7	1
Hagamsa	*Carissa edulis*	1	Sept-Dec	shrub	5	seed	7	1
Goraa	*Rubusspp*	1	Sept-Oct	shrub	5	seed	7	1
Siddisa	*Trifoliumsp*	1	July-Oct	grass	5	seed	6	2
Muuzii	*Musa paradisca*	1	Sept-Oct	shrub	5	vegetation	7	2
Harbuu	*Ficusvasta*	1	Oct- Dec	tree	3	seed	7	2
Dannisaa	*Dombeyaaethiopica*	1	Sept- Oct	tree	5	seed	7	1
Adaami	*Euphorbia spp*	1	Sept -Oct	shrub	3	vegetation	7	2
Waddessa	*Cordia africana*	1	Jan -July	tree	5	-	7	2
Bakela	*Viciafaba*	1	Sept	shrub	3	seed	6	2
Sinqoo	*Trigonellafoeniculum*	1	Dec	herb	3	seed	7	2
Dabaaqula	*Cucuerbita pepo*	1	July-Sept	herb	3	seed	7	2
Mossobila/ siqaaqibee	*Ocimumbasilicum*	-	through out	herb	5	seed	7	2
Qarxammee		1	Jan	tree	5	seed	6	2
Sokorruu		1	Oct-Dec	herb	5	seed	6	2
Adaadoo		1	March	tree	5	seed	6	2
Tuufoo		1	Sept-Oct	herb	3	seed and vegetation	6	2
Atara	*Pisumsativum*	1	Sept-Oct	pulse	5	seed	7	2

(Prioritization based on the honey bee preference (1*= major, 2*=minor), source of (3*=pollen,4*=Nectar,5*=both abundance of plants (6*=good, 7*=poor),

4.8.2.2.Availability of honeybee resource

To start beekeeping; one person must find the colony by any means which is simple way to him/her. From all methods of catching swarm, obtaining from the environment is more advantageous than the other methods because it does not incur cost, and one can catch several colonies in one season. In the study area, most beekeepers start beekeeping by catching the swarm from the environment and following by gift from their parents and also from their relatives. This explains the environment has good access to honey bee resource.

4.8.2.3.Increasing attention and focus from the government

To strength the apiculture sector and to produce the hive products and benefit from the activities of honey bees the attention of government is very important. Now days the government of Ethiopia focused on the apiculture sector by interconnection with natural resource conservation. In the study area, both government and non –government organizations undertake many activities in the form of training and helping the top beekeepers by providing them some modern bee hives.

4.8.2.4.Increasing hive products' demand

The rising of hive product is depending on many reasons:-management, floral resource, knowledge of honey flow period and so on. To increase the hive products, one beekeeper should update his/her knowledge by working many years with honey bee and have technology training from government and non –government organizations. From the study area, the production of honey increased from the year to the year because of increased intensity and frequency of giving training in the area.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1.Conclusions

Generally, study area is potential for honey production. Traditional, transitional and frame honey production systems were dominant in the study area, however, the availability of traditional honey production system is still the most known in three agro-ecologies. In high land agroecology of study area, traditional, transitional and frame honey production systems were practiced in the same way where in the mid land and low land agro ecologies, frame and transitional honey production system were more performed. Beekeepers have different knowledge depend on type of honey production system. On traditional honey production system beekeepers develop skill from family and environment. Illiterate beekeepers are more tangible on traditional honey production system, where literate beekeepers are work more with transitional and frame / modern honey production system. There is mixing placement of traditional, transitional and frame hives and back yard apiary site is the major one in the study area. Majority of the beekeepers store their honey in traditional materials.

There was no honey marketing channel at district and village level. Beekeepers sell their honey to tej producers and costumers. The prices of honey always decided by buyers depend on the time of honey harvesting season and color of honey. Red honey has fewer prices, where white and yellow honey has high price value. Honey production in the study area has been faced with multiple constraints (the effect of agro chemicals application on crops, pest and predators, bee disease, absconding, shortage of bee forage, shortage of water, absence of market center,) but study area has a lot of opportunities (availability of bee flora, honeybee resource, attention and focus from the government and non-government). Hence farmers in the mid land and low land should practice frame and transitional hive honey production system.

5.2.Recommendations

From this study the following recommendations can be prepared for the present and future works in apiculture sub sector in the study area.

- Since both honey yield and production systems with transitional and frame hive more in mid land and low land, these two agro ecologies can be considered as potential for honey production.
- In the study area the government and non-government should be contributed the male and female beekeepers proportionally in different beekeeping trainings.
- To spray applications such as pesticides especially on crops, it is first important to evaluate the time of application in such a way that it does not have an effect on the bees.
- The effect of wax moth is difficult to control by beekeepers hence, the method which is approved for this pest is that all hives which have wax moth are removing and melted the infested comb and making the new foundation sheet should be addressed and supported by public and private.
- The government and the non-government should be organized the market center for beekeepers.
- Training and educating beekeepers in the study area about storage of honey, good husbandry and management, seasonal management such as transferring time, follow ups after colony transferring, at dearth period, and cold seasons should be addressed by public and private service providers.

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7. APPENDIXES

Appendix I

Interview Guides and survey apparatuses

BAHIR DAR UNIVERSITY
COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

Diagnostic Survey on Characterization of Honey Production and Marketing Systems, challenges and opportunities in Ada Berga district, Oromia region, Ethiopia

Questionnaire

D_____/M_____/Y_____

A. Region-------- B. Zone ---------- C. Woreda ----------

Woreda Description

Highlands's ___ (%) No. Beekeepers ____No Colonies Trd ____ Trs___ Mod _____
Midland ____ (%) No. Beekeepers ____ No Colonies Trd__Trs_____Mod _____
Lowland ___(%) No. Beekeepers ___ No Colonies Trd_Trs_____ Mod _____
Altitude _____ fts, Rf.___mm To ___ mmRH _____

I.To be completed based on Respondent's Reply

A. Name of respondent _____

1. PA/ Kebele _____ 2. Village (Got) _____
3. Sex _____ 4. Age _____
5. Occupation_____6. Religion_____
7. Education level_____8. Marital status_____

II. BEEKEEPING SITUATION

1. Do you have own honey bee colonies?

A. Yes B. No

2. How do you get colony to start beekeeping practices? Source of bees

A. Gift from parent's B .Catching swarming bee
C. Buying D. robbing from caves and forests

E. Other (specify) _____

3. When did you start beekeeping?

A. last 5 years

B. last 5 – 10 years

C. last 10 – 15 years

D. before 15 years

2. What types of hives do you have?

Table7. 1:Types of hive

No.	Type of hive	Occupied with bees	empty	Total
1	Traditional			
2	Transitional			
3	Frame			

6. What are the driving forces to engage in beekeeping practices?

A. Income B. Home consumption

C. Both A & B D. Others (specify) _____

6. What is the advantage and disadvantage of forest beekeeping on honey production?

7. Where did you place your colonies?

Table7. 2: site /placement of hive

Site or placement of hive	Traditional	Transitional	Frame hive
A. Backyard			
B. Under the eaves of the house			
C. Inside the house			
D. Hanging on trees near homestead			
E. Hanging on trees in forests			
F. Others (specify)			

8. What is the amount of honey products you got in 2014?

Table7. 3: Amount of honey yield before one year

No	**Colony product**	**Unit**	**Traditional hive**	**Transitional hive**	**Frame hive**
1	Extracted honey	Kg/colony/year			
2	Crude honey	Kg/colony/year			

9. Honey yields per colony by hive type you got in 2015?

Table7. 4: Honey yield in 2015

No.	Type of hive	Kg/hive/year	Remark
1	Traditional		
2	Transitional		
3	Frame		

10. What kind of management has been applied for safe honey storage?

A. Use of appropriate containers B. Use of materials which they have (any)

11. When is the peak honey production period? From _____to_____ (Months)

III. Agrochemical applications

12. Do you use agrochemicals/chemicals in your locality?

A. Yes B. No

13. If yes, why do you apply agro chemicals/chemicals?

A. Crop pest control B. Weeds control

C. Malaria control D. Others (specify):_____

14. Did you find dead bees around the farm after you apply the chemicals?

A. Yes B. No

15. In what stage of the crop growth you apply the chemicals?

A. Early growth stage B. mid growth stage

C. at the beginning of flowering D. As disease signs are observed

E. Other (specify) _____

16. Are you aware of agrochemical effects on honey bees?

A. Yes B. No

17. If yes, who and how do you get the concept?

_____

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

A. Herbicides _____ B. Insecticides_____

C. Pesticides_____

19. At what time of the day do you apply the chemicals?

A. Morning B. late evening

C. Middle of the day D. Night

20. What is your reason to apply at this time? (For the choice of Q no. 19)

_____

_____

21. Have you faced agrochemicals/chemicals effect on honey bees?

A. Yes B. No.

22. What are the major signs observed on honey bees related to these chemicals?

A. Massive death B. Aggressiveness

C. Dead brood

D. Queen death E. worker bee's death at hive entrance

23. If your answer for Q.21 is yes how many colonies did you lost due to chemicals?

Table7. 5: The effect of chemicals on honey yield

No	Types of Beehive	Effect of Agrochemicals			
		No. of lost colonies by chemicals	Honey lose in Kg	Measures you taken	Estimated price/ETB
1	Traditional				
2	Intermediate				
3	Movable-frame				

24. Do agrochemical users announce the beekeepers before application?

A. Yes B. No

IV. **Poisonous plants**

25. Have you ever faced poisoned honey?

A. Yes B. No

26. If yes, what do you think the reason? It is due to:

A. The Source Plant B. The Container

C. Time of Storage D. The Environment

E. Poisonous agrochemicals F. I don't know the reason

G. Others (specify) _____

27. Plants known for their poisoning effect and symptoms

Table7. 6: poisoning plants

No.	Plant name	Flowering month (s)	Symptoms and cases
1			
2			
3			

V. Socio economic Factors

28. Do you sale your honey?

A. Yes B. No

29. Where is mostly honey market in the Woreda?

30. What is the means of transporting of honey to the market?

A. By using human labor B. By packed animal labor

C. By using vehicle D. specify if others_____

31. How much time does it take to honey market for bee keepers? _____

32. Who are the main buyers of honey in the area?

A. Tej brewery B. Retailers C. Whole sellers
D. Honey market cooperatives E. Direct consumers

33. What seems honey channel in the worked? (From producers to where)? _____

34. Is there price difference for similar honey in different market place of the Woreda?

35. Do bee keepers get market information of honey?

A. Yes, B. No

36. If your answer is yes, on Q no, 35 where do they get?

37. During honey harvesting what is an average price of one kg/birr of honey?

A. white color B. yellow color C. Red color D. Black color

E. mixed color

38. What are major constraints of honey market? _____

39. What are recommended solutions for constraints of honey market? _____

40. What are opportunists for honey market development in the Woreda? _____

Appendix II

1. What are the major natural bee plants (trees)?

Table7. 7: Major natural bee plants

No.	Local name of the plant	Scientific name of the plant	No. of flowering periods	Flowering periods (months)	Nature of the plant (tree, shrub, herb)	Source (Pollen, Nectar, both)	prioritization based on honey bee preference
1							
2							
3							
4							
5							

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VI.HONEYBEE DISEASE AND PESTS

2. Is there a decreasing trend in the number of colonies you owned?

A. Yes B. No

3. If there are decreasing trend in no of colonies and hive product over the year, what do you think the case?

Table7. 8: Challenges on honey bee colony

Causes	**Rank**	**Indicate change you observed for your answer**
Lack of bee forage		
Water		
Pest & predators		
Diseases		
Pesticides and herbicides		
Absconding		
Death		
Others, Specify		

Table7. 9: Pest and Predators

SN	Common name	Local name	Order of importance	SN	Common name	Local name	Order of importance
1	Ants			8	Death head hawks moth		
2	Wax moth			9	Lizards		
3	Hamagot			10	Toads		
4	Spider			11	Snakes		
5	Wasps			12	Praymanteds		
6	Birds			13	Mice		
7	Beetles			14	Bee lice		
				15	Others		

4. When do you most likely observe bee disease & enemies in the colony?

Table7. 10: Occurrences of pests and predators.

SN	Beekeeping season	Diseases		Pests		Other sign	
		Observed	Not infected	Observed	Not infested	Observed	Not infested
1	Sep. - Nov	☐		☐		☐	
2	Dec - Feb	☐		☐		☐	
3	March- May	☐		☐		☐	
4	June- August	☐		☐		☐	
5	Others Specify	☐		☐		☐	

8. APPENDIX FIGURE

Figure 8. 1 back yard apiary site

Figure 8. 2 Honey bee flora

Figure 8. 3 mixed placement of hives

9. BIOGRAPHY

I, the author of this M.Sc. thesis, was born in April 1985 from my father Mekonnen Kenajima and my mother Beyenech Amenu in Horo Guduru Wollega zone, Oromia region. I joined my elementary school, at Bikila Negero, High school and Preparatory, at Hareto Secondary and Preparatory school. Then after the national examination, I joined Wollega University in 2008 where I studied Applied Biology and graduated in June, 2010 with BSc degree. Soon after graduation, I was employed by Haro sebu Agricultural Research center (HSARC) department of Animal Science as an Apiculture Researcher. I then and there joined the college of Graduate studies of Bahir Dar University in October 2014 to pursue masters of Science and successfully completed in November, 2016 with M.Sc. Degree in Apiculture